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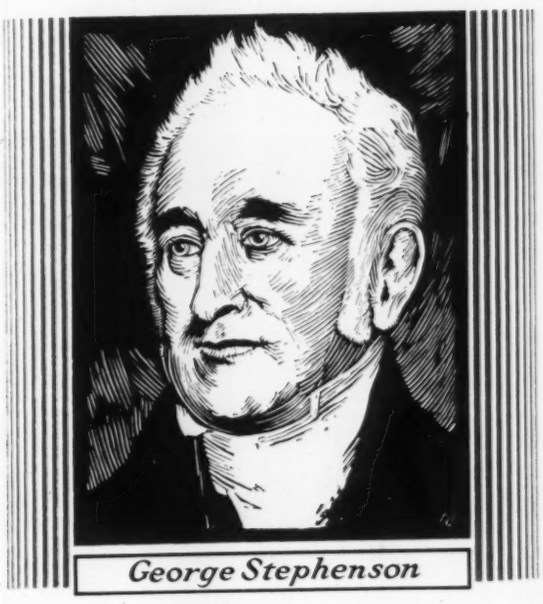
MACHINE DESIGN



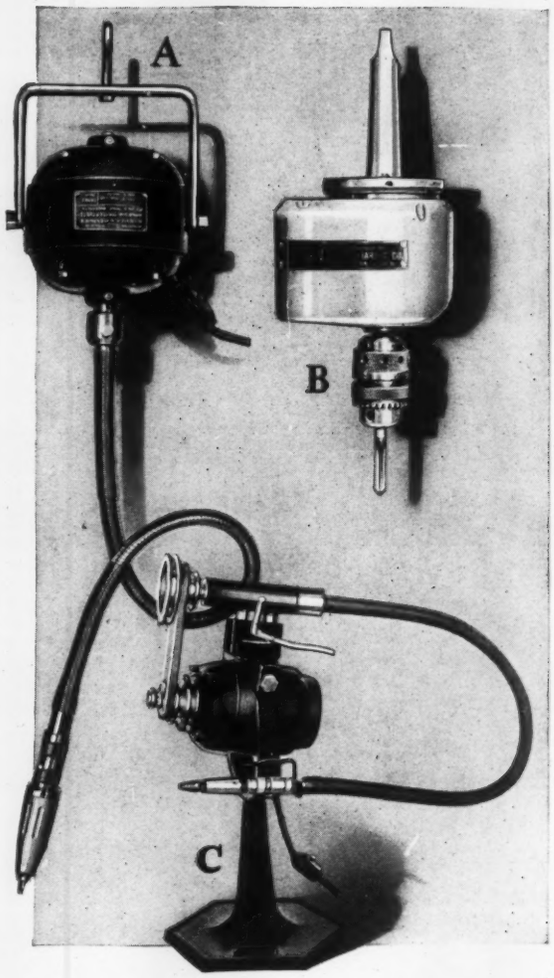
George Stephenson

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

Precision Bearings for SEMI-PORTABLE POWER TOOLS . . .

THE semi-portable power unit, with flexible shaft from motor to rotating tool, is gaining increasing acceptance as a time-saver and cost-cutter on many machine and repair shop operations. * * * * In equipping its latest models with NORMA-HOFFMANN Ball Bearings, the Charles L. Jarvis Co. (Gildersleeve, Conn.) has achieved the following advantages:—(a) minimum power loss between motor and tool, owing to the high anti-friction efficiency of PRECISION Bearings; (b) maximum durability, due to the time-tested stand-up-ability of PRECISION Bearings; (c) perfect freedom, without looseness or vibration in the bearings; (d) sustained true alignment (notably important in the Tapper illustrated). Typical advanced units from the Jarvis line are here pictured. * * * * Whatever the load, speed or duty, the qualities for which PRECISION stands merit the most careful investigation and comparison by all concerned with the economical handling of rotating loads. For the superior load-ability, speed-ability and service-ability of PRECISION Bearings are attested by performance records over a score of years. * * * * Write for the Catalog. Let our engineers work with you.

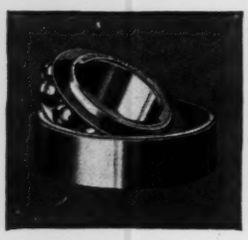


A The JARVIS Setter or Screw-Driver uses two PRECISION Bearings in the handpiece.

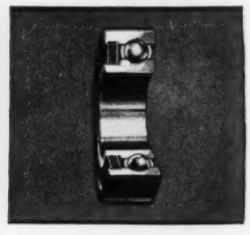
B The JARVIS "BIAX" High Speed Tapping Attachment; maximum forward speed, 3500 R.P.M.; reverse speed, 7000 R.P.M.; six PRECISION Bearings carrying main shaft, pinion shaft and chuck shank. Here PRECISION eliminates broken taps at high production speeds.

C The "MULTI-JARVIS" Multi-Speed Filing, Grinding, Sanding and Polishing Machine; four speeds—1000, 2000, 4000, 7000 R.P.M.; two PRECISION Bearings in the countershaft, three in the handpiece and jaw connection. Bench type illustrated; available also with roller floor stand or overhead trolley suspension.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.



"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST



Itemized Index for March, 1933

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

Design Calculations:
Torque, Edit. 20

Design Problems:
Appearance, designing for, Edit. 11, 12
Drilling, designing for, Edit. 30, 31, 32 33
Friction, utilizing, Edit. 17
Inventions, protecting, Edit. 25, 26, 27, 28
Motor speeds, balancing, Edit. 15R
Motors, selecting proper, edit. 18, 19, 20, 21, 56R
Requirements, satisfying service, Edit. 29, 58
Reversing, electrically, Edit. 18, 19, 20, 21, 56R
Streamlining, Edit. 16
Vibration, combating, Edit. 41, 42L
Vibration, determining causes of, Edit. 14

Finishes:
Protective coatings, Edit. 52R, 54R; Adv. 51

Materials:
Alloys (Hard-Facing), Adv. 55
Alloys (Nickel), Edit. 46R, 48L; Adv. 47
Alloys (Steel), Edit. 58R; Adv. 6
Aluminum, Edit. 44L
Beryllium copper, Edit. 23, 24
Zinc, Adv. 67

Mechanisms:
Air conditioning, Edit. 44
Assorting, Edit. 14R, 15L
Automatic feeding, Edit. 29, 58
Cam, Edit. 15
Free wheeling, Edit. 42
Recording, Edit. 14
Vibrating, Edit. 41
Water cooling, Edit. 16R

Organization and Equipment:
Engineering department, Adv. 65R
Estimating, procedure for, Edit. 37L
Patent law and patent activity, Edit. 25, 26, 27, 28, 44
Research, value to industry, Edit. 22, 44R

Parts:
Bearings, Edit. 24L, 37; Adv. 2, 9, 49, 53
Clutches, Edit. 42, 46L
Controls (Electrical), Edit. 50R, 52R; Adv. 66L, 68
Drives, Edit. 13, 46, 48; Adv. 50L, 57, 58
Electronic equipment, Edit. 16R, 17L, 48R, 50R
Fastenings, Edit. 48R; Adv. 54L, 60L
Heating units, Adv. 62L, 64L
Lubrication and lubricating equipment, Edit. 16R, 17L; Adv. 59
Motors, Edit. 18, 19, 20, 21, 54R, 56R; Adv. 3, 10, 52L, 56L, 61
Packing glands and packing, Adv. 4
Pumps, Edit. 12, 13, 48L; Adv. 64L
Recorders, Edit. 54R
Springs, Edit. 23
Tubes, Edit. 13R, 23R, 24
Universal joints, Edit. 42R
Welded parts and equipment, Edit. 24R
Wire, Edit. 23, 24

Principles:
Hydraulic, Edit. 12, 13

Production:
Beryllium copper, machining, Edit. 24R
Holes, specifying correctly, Edit. 30, 31, 32, 33

Sales and Sales Department:
Appearance incorporating, Edit. 11, 12, 13

Standardization:
Ball bearings, Edit. 37R
Bushings, Edit. 37
Effect of depression on, Edit. 44R, 45L
Machine speeds, Edit. 45R

THE value of research is apparent to every engineer. Keeping informed of what research data is available, however, has presented somewhat of a problem. To assist readers in this direction, Machine Design gives a selected list of "Research Publications", an outline review of the contents and where and how they can be obtained. Thus, considerable pertinent and usable technical information is made available to the engineer. Many of the publications listed can be had for a nominal sum. This department will be found in this issue on page 62.

Calendar of Meetings and Expositions

March 13-16—National Railway Appliance Exhibition. To be held at Chicago. C. W. Kelly, 1014 South Michigan avenue, Chicago, is manager of the exhibition.

March 15-17—American Railway Engineering association. Annual meeting to be held in Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary.

March 22-24—Re-Engineering for Economical Manufacture. Conference planned by Case School of Applied Science, has been postponed.

March 26-April 1—American Chemical society. Eighty-fifth meeting to be held at Washington. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary of the society.

April 13—American Management association. Job Order production division and mass production division conference to be held in Cleveland will include discussion of product design and its influence on set-up time. Kenneth B. Andersen, 20 Vesey street, New York, is secretary of the society.

April 24-28—Knitting Arts Exposition. Displays of machinery for use in the textile industry will be held at Commercial Museum, Philadelphia. Information may be obtained by writing the exposition management at Philadelphia.

April 26-28—American Welding society. Annual meeting to be held in Engineering Societies building, New York. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary of the society.

May 4-6—Gear Manufacturers association. Annual meeting to be held at Wilkinsburg, Pa. J. C. McQuiston, First National Bank building, Wilkinsburg, is secretary- manager.

May 11-13—Electrochemical society. Spring meeting to be held at Montreal, Que., Dr. Colin G. Fink, Columbia university, New York, is secretary of the society.

May 29-30—International Association of Blue Print and Allied Industries. Annual meeting and exhibition of equipment to be held at Buffalo. R. Bloomfield, 161 Washington street, New York, is secretary of the society.

June 1—World's Fair. 1933 exposition will open on this date at Chicago. Engineers' day will be June 28. Information may be obtained from the management at Burnham park, Chicago.

June 12-15—National Association of Purchasing Agents. Exposition and annual meeting to be held at Hotel Statler, Boston. G. A. Renard, 11 Park Place, New York, is secretary of the association.

June 12-16—American Oil Burner association. Tenth annual meeting and exposition of equipment to be held at Hotel Stevens, Chicago. Harry F. Tapp, 342 Madison avenue, New York, is secretary of the association.

June 19-23—Confectioner's National Exposition. Annual meeting of the National Confectioner's association of the United States to be held at Chicago will include exhibition of equipment. Information may be obtained from F. Records, 111 West Washington street, Chicago

June 20-23—American Foundrymen's association. To hold annual meeting and exhibition of equipment at Hotel Stevens, Chicago. C. E. Hoyt, 222 West Adams street, Chicago, is secretary of the association.

June 25-30—Sixth Midwest Engineering and Power exposition. To be held at the Coliseum, Chicago. Exposition headquarters are located at 308 West Washington street, Chicago.

June 26-29—American Society of Mechanical Engineers. Semiannual meeting of the society to be held at Hotel Stevens, Chicago. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

June 26-30—American Institute of Electrical Engineers. Semiannual meeting to be held at Chicago. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary of the institute.

June 26-30—American Society for Testing Materials. Exposition of testing equipment and annual meeting to be held at Hotel Stevens, Chicago. C. L. Warwick, 1315 Spruce street, Philadelphia, is secretary of the society.

June 27-30—Society of Industrial Engineers. Annual meeting to be held at Hotel Stevens, Chicago. George C. Dent, 205 West Wacker Drive, Chicago, is secretary of the society.

MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
March, 1933 Vol. 5—No. 3

Designing for Style Plus Mechanical Perfection

By George C. Lawrie

IN UTILITARIAN equipment such as testing machines sufficient attention has not been given, in many cases, to the matter of style. The usual procedure in design has been to allow the appearance of the machine to be the more or less haphazard result obtained by proper arrangement of the mechanisms. It formerly was not considered imperative that a machine in this class embodying mechanical merit should possess features of external design appealing strongly to the user or prospective buyer.

This relatively common attitude prevailed at the time a new universal testing machine of the hydraulic type was designed to meet the growing demand. The resulting mechanically efficient unit appeared as in Fig. 2. However, it was decided that a precision machine should convey the impression of its worth to all who might see or consider it, rather than forcing the mechanism to overcome the negative reaction caused by an unsightly, even though otherwise perfect, arrangement.

Redesign from the appearance angle logically began after all mechanical difficulties had been overcome. A designer in the graphic arts was called in for consultation and every attempt was made to box in and hide as far as possible the various working parts, giving the machine the stamp of rugged simplicity and beauty and at the same time protecting the working mechanisms from particles of grit, dust and dirt which might work their way in on a more exposed machine. This new design produced by Riehle Bros. Testing Machine Co., Philadelphia, is shown in Fig. 3.

Universal approval of the new machine brought about a complete redesign of all machines manufactured in the line. A family re-

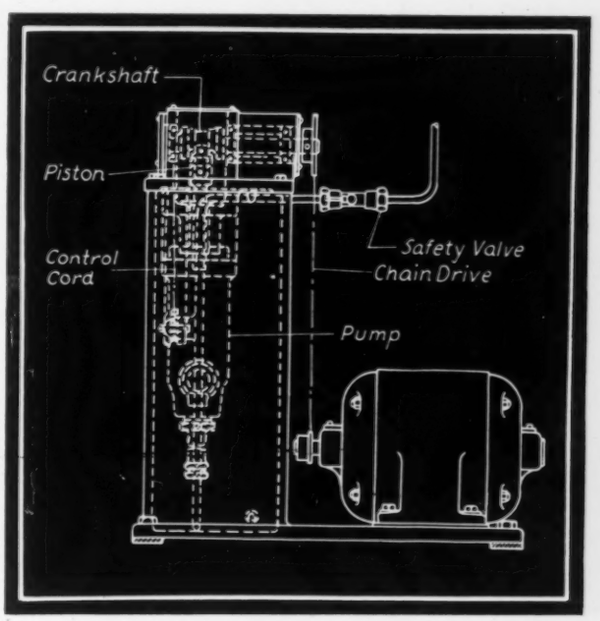


Fig. 1—Pump is mounted in an inverted position on the under side of the cover plate

semblance has been incorporated so that the pendulum type torsional testing machine, Fig. 5 and the hand operated production brinell machine, Fig. 6 could be distinguished easily as products of the same manufacturer as the machine shown in Fig. 3.

It is believed that the redesign improves the usefulness of the equipment because, with its external appearance so decidedly in its favor the machine will be operated more carefully, hence providing more accurate results. Also, the man operating the machine and responsible for its maintenance will take far better care of it than he would take of one resembling the machine illustrated by Fig. 2. In every instance beauty of appearance has been secondary to utility, and the designer in the graphic arts has not been called in until the engineering features of the machine were completed. It then has been up to him to design its external appearance, in conjunction with the engineering staff, so that the original engineering features of each machine are maintained. On some equipment it might be better to consider appearance earlier in the design, but the former course proved more acceptable in this case.

Family resemblance and compactness were two of the major considerations in the design of a recently introduced 30,000 pound capacity universal testing machine of the hydraulic type, Fig. 4. It was developed to test all of the smaller standard specimens such as headed and threaded tensile specimens, arbitration bars and compression specimens, and to be convenient to operate.

Physical requirements for the specimens having been determined, the method of applying load to the specimen was the next consideration. From the point of view of economy as well as flexibility and convenience of operation, hydraulic load application was decided upon. This meant an hydraulic cylinder with either a packed or unpacked plunger. The type depended to a great extent on the method to be used in measuring the applied load. In view of the necessity for low cost, the most direct and economical means of load indication was self-evident—the hydraulic gage connected to the loading cylinder.

The employment of an hydraulic gage for load indication made the use of the unpacked plunger imparative, even though the cost was somewhat above that of the packed plunger. This increase in cost is at least partially offset by entire freedom from future trouble from leaky packings and, most important of all, practically complete elimination of friction of the plunger in the cylinder. The close fit of the plunger required to hold the oil at 3000 pounds per square inch pressure and the extremely fine finish of the surfaces required to obtain such a fit together with the thin film of oil maintained between these surfaces under the high pressure guarantees absence of friction.

Pressure in the system is furnished by a special single plunger fuel injection pump arranged for hydraulic work. It is mounted in an inverted position on the under side of the coverplate of the oil reservoir and is completely immersed in the oil, Fig. 1. A small crankshaft is mounted in ball bearings on top of the coverplate, on the

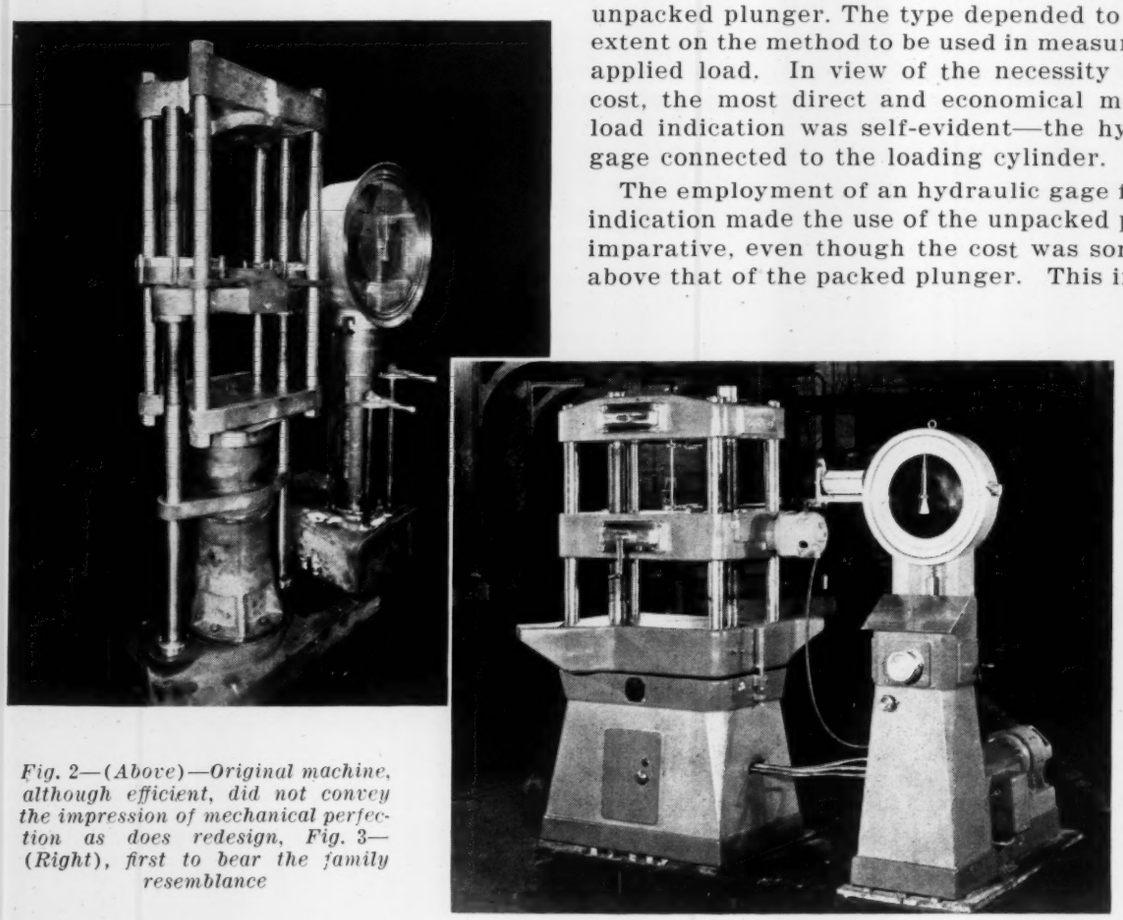


Fig. 2—(Above)—Original machine, although efficient, did not convey the impression of mechanical perfection as does redesign, Fig. 3—(Right), first to bear the family resemblance

end of which is the chain drive from the motor, mounted on the base of the pumping unit. The crank pin bears directly against a ball bearing mounted in the top end of a plunger guided in the reservoir cover and bearing against the main plunger of the pump.

Self-Contained Pumping Unit Used

In order to keep the machine as compact as possible it was decided to make the pumping unit a completely self-contained unit, consisting of the pump, oil reservoir and motor, which could be assembled outside the machine and slipped into the base of the machine with but two connections necessary to complete the installation. In the first design the eccentric for driving the pump was mounted directly on the shaft of a combined motor and reducer, in turn mounted on top of the oil reservoir. This construction, however, because of the rather long overhang of the eccentric on the extended motor shaft set up vibrations in operation causing excessive and undesirable vibration of the gage pointer. The condition was aggravated by the fact the entire pumping unit was supported on lugs on the inside of the base casting about 1½ feet from the floor.

On subsequent machines the pumping unit was redesigned to be supported as near as possible to the floor, and, in addition, an insulating material was placed between the unit and the base flange of the machine. The motor also was placed on this base and connected to the crank shaft by a chain drive. This redesign gives better access to the unit and makes installation and connection easier but, more important, it reduces vibration within allowable limits.

On the original machine extra heavy steel pipe and screwed fittings were used but due to the desire to conceal all piping, the piping job turned out to be difficult with such material. Consequently in the redesign all piping was changed to the same size copper tubing and connections made with special screw connections. The extra heavy copper tubing can be bent more easily to to suit requirements in the cramped space in which it is located.

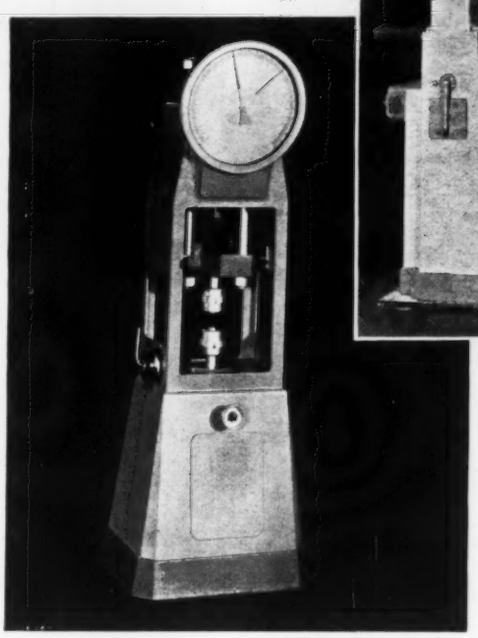


Fig. 4—Compactness as well as appearance was stressed in the specifications for 30,000 pound machine

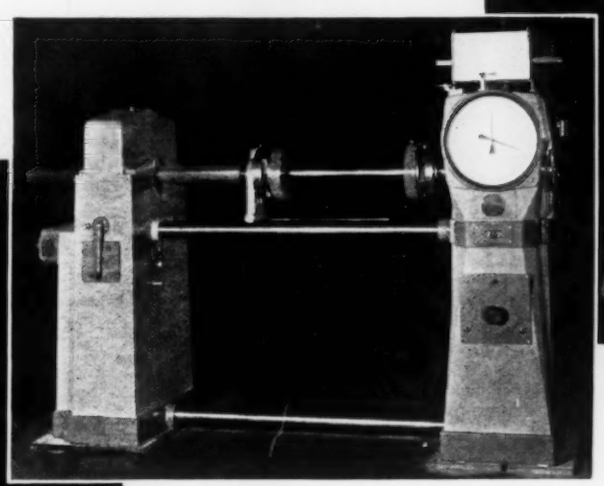


Fig. 5 — (Left) — Torsional testing machine and brinell machine, Fig. 6—(Above), also were designed to present family resemblance

The machine is designed for maximum ease and convenience of operation. The operator, when in a seated position, has easy access to all controls and also may read the dial easily since it is tilted forward to allow reading without error of parallax. The pump discharge and consequently the speed of testing is controlled by means of the handle on the left side of the machine, which operates over a graduated arc indicating the speed. A toggle switch controlling the motor is mounted at the right and a return valve for returning the plunger at the completion of the test is mounted on the front of the machine as shown.

In finishing the machine all surfaces to be painted were filled carefully and rubbed down and finished in two tones of gray lacquer, sprayed on. The final result was a machine of pleasing appearance, universal in its uses, easy of operation, and available at a low price.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Recording Vibrations on Film

BEFORE vibration can be combated successfully its causes must be determined. Analysis of these embody investigation, on instruments for which the designer should have a liberal knowledge (M. D., March, 1932). A new photo-seismograph, together with a unique method of interpreting its records has been developed to assist the engineer in removing the limitations imposed upon machine efficiency by vibration. Use of this new technique of vibration engineering has furnished designers with data enabling them to increase the speed and precision of machines and to reduce breakage or loosening of parts.

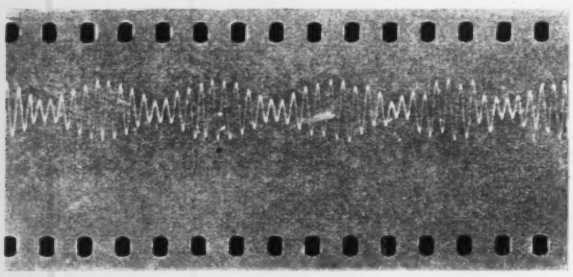


Fig. 1—Strip of film employed in photo-seismograph to record magnified vibrations of machinery

The photo-seismograph is essentially a highly compact and portable unit by means of which vibrations are magnified and recorded on a motion picture film, Fig. 1. A film is employed rather than a chart because of the friction the latter method involves, this being particularly disturbing in recording highly magnified frequencies at low amplitude. The strip of film shown herewith provides a simple vibration record magnified 35 times of two lines of shafting running at nearly the same speed, both lines being properly aligned. The instrument was developed by Barss, Knobel & Young, in association with Arthur D. Little Inc., Cambridge, Mass., providing another use for film in technical work.

Better design obviates vibration, accomplished by achieving proper balance, adding strength at the point and to the degree indicated by the analytical data, and by placing isolating materials and devices appropriate to the frequency and amplitude of the vibrations remaining.

Slotted Disk Used for Assorting

FREQUENTLY a development in one field will open avenues by which problems in other divisions of machine design may be approached. This transposition of ideas is becoming more important and progress depends largely on it. In developing a mechanical shuffle-dealing bridge table it is possible that there has been laid down the basis, for instance, of a new method of assorting different flavors of candies or other goods, pieces of which would of course have to be relatively similar in shape.

The mechanical bridge table referred to was designed by Laurens Hammond and is manufac-

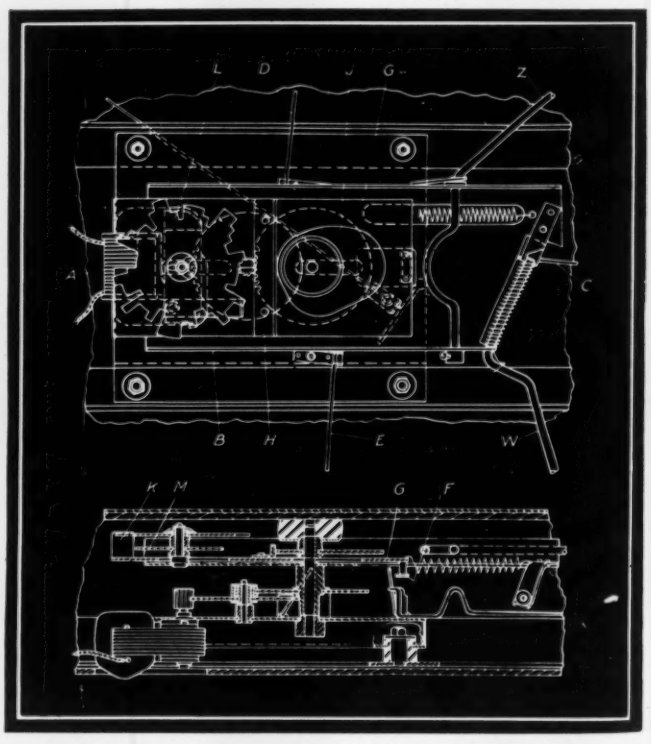


Fig. 2—A notched indexing plate actuated by a ratchet through a stationary cam, shuffles and deals playing cards

tured by Hammond Clock Co., Chicago. Ingenious is the arrangement for selecting the station at which the playing cards will be deposited by a pusher arm that carries the cards one by one around the circular track. In Fig. 2 is shown the central control and actuating mechanism. When the tray bearing the deck of cards is pushed into position a toggle switch is operated to start the electric motor *A* geared to turnable *B* which then commences to rotate.

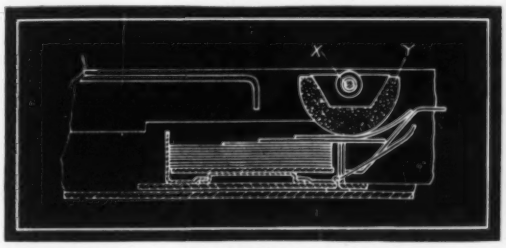


Fig. 3—Card picker employs sponge rubber thumb which moves card by friction

Stationed on one end of the turntable is the notched control plate or selector *L* with 52 notches, 13 each of the same depth, the sequence of the notches of different depths being determined mathematically to give a thorough shuffling. Since the notched selector plate is secured to a ratchet index wheel *M*, the former will be rotated through one fifty-second of a revolution upon each revolution of sliding plate *G* which carries a pawl to index the wheel *M* as it moves to the left in Fig. 2. Inasmuch as the stationary cam *J* has but one high point, plate *G* will reciprocate but once upon each revolution of the turntable. The sliding plate normally is pulled to the right by a spring until the face of angle plate *H* is in engagement with cam *J*.

Deflects Card in Receptacle

Depending upon the angular position of the notched selector plate *L* with respect to the selector lug *K* fastened on the slide plate G, this plate will move inwardly such distance that switch rod actuator *F* attached to the opposite end of the sliding member, will be in a position to engage one of the upturned ends of the switch rods *C*, *D* or *E*. When the selector lug *K* has contacted with one of the 52 stop surfaces of the selector plate *L* the upturned end of one of the switch rods *C*, *D* or *E* will be engaged by the switch actuator *F* to operate the card switch at its respective station, thereby deflecting the card into the designated receptacle.

The card picker mechanism (Fig. 3) is carried on the bent arm *W*, shown in Fig. 2. It comprises essentially a sponge rubber picker thumb *Y* held in a metal clamp. Friction of this thumb on the topmost card causes the card to be carried up the inclined rails on to the track. Subsequently the rubber roller *X* travels up an inclined portion formed upon the inner track, thereby raising the picker thumb off the surface of the card. The conveying mechanism that continues the movement of the card from the position in which it is left by the picker, consists of the arm *Z*, Fig. 2. A carrier bracket on the outer extremity of this arm contacts the edge of the card and pushes it along the track until it comes to the designated pocket and is deposited.

Motor Speeds Balanced Automatically

APPLICATION of a twin motor drive to a mooring mast holds a suggestion which should prove valuable to designers. The problem involves the necessity of varying automatically the relative speeds of two pairs of motors for propelling the structure over curved tracks spaced 65 feet apart. Located at Sunnyvale, Calif., the movable mast rises some 70 feet above ground (Fig. 4).

Two railroad tracks on which the mast is carried run through the hangar and extend outward a considerable distance, the length of the track being practically a mile. In their course the tracks make a sweeping curve, which introduced a problem in designing the propulsion

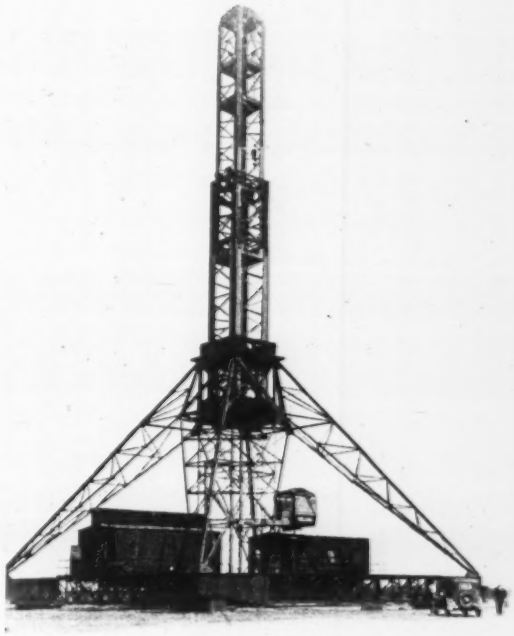


Fig. 4—Speed of mooring mast driving motors is balanced on curved track

equipment. Since the tracks are 65 feet apart it is obvious that the one on the outer curve is longer than the other and the wheels on it must travel faster than those on the inner track. Relative speeds of the wheels not only must

be correct at all times but the ratio must be maintained automatically.

Four shunt wound direct current General Electric motors, one on each corner truck, provide the locomotion. Each motor on the inside curve is connected electrically with the corresponding motor on the outside curve and the two are fed by one generator, while the other pair of motors is fed by another generator. In each pair the armatures are in series and therefore take the same current and develop the same torque.

Mechanical resistance encountered by car wheels on a curved track is of course greater on a sharp curve than on one less sharp, and each motor therefore on the inside track works harder than its mate. This extra effort slows down the motor, lowering its armature voltage. Since the armatures of the two motors are in series across a fixed potential, lowering the voltage of one armature increases the voltage of the other with the result that if one motor runs slower than its partner, the other picks up speed. Thus a balance is established automatically that insures smooth travel of all trucks around the curve.

Beauty, Efficiency in Streamlining

MINIMUM resistance to passage through air, freedom from protuberances, and a clean graceful appearance are three of the characteristics which mark a streamlined vehicle. These objectives in design continue to find wider acceptance among automobile manufacturers. Pierce-Arrow has won the attention of the public eye with its Silver Arrow, Fig. 5. This example alone bears out the broad possibilities of the new mode to which MACHINE DESIGN has pointed many times in the past as one of the most progressive steps ever made in automotive refinement.

Consider the ultra-streamlined body of this car which is capable of 115 miles an hour and a cruising speed of 80 miles an hour. Note how smoothly the streamlines converge at the rear of the car and the manner in which the headlights blend into the contour of the fenders. The spare tire is carried in a shrouded compartment behind the front wheel, preventing unbroken lines which would disrupt the plan. A sloping windshield sweeps gracefully to the metal roof, giving an easy rotund profile which is reminiscent of a yacht.

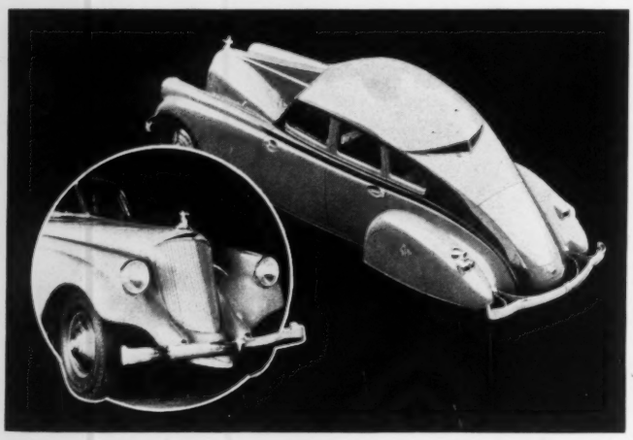


Fig. 5—Possibilities of streamlining are sensationally disclosed by this ultra-modern automobile designed by Pierce-Arrow engineers

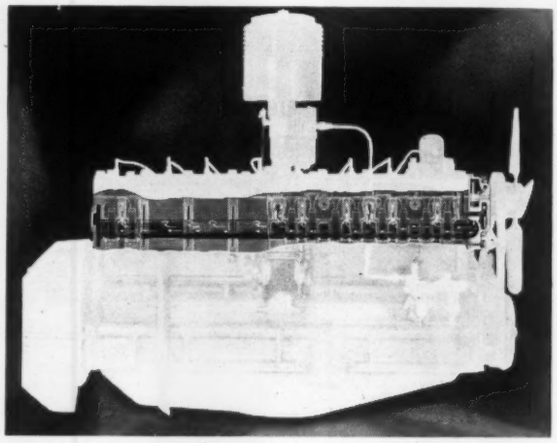


Fig. 6—A water distributing tube running full length of engine block cools the valves

The designer, while concerned extensively with the exterior of the present day automobile, has not neglected the mechanical end. Although streamlining has measurably increased efficiency it still is necessary to incorporate refinement in power plant design to match that improvement. Pontiac is employing a water distributing tube, Fig. 6, to cool the valves of its engine. This tube runs the full length of the cylinder block and circulates water directly around each of the eight exhaust valve seats. This is of course in addition to the system which carries coolant around each cylinder barrel. By such a combination only a slight variation in temperature between the front and rear of the engine prevails. Employment of separate exhaust valve ports permits circulation of water around each valve seat.

Electric Eye Now Inspects Oil

ALMOST incomprehensible is the scope of the vacuum tube in industry. Sorting, inspection, gaging, controlling and testing are being increasingly accomplished more efficiently by the photoelectric method. Now an electronic device makes it possible to determine proportionately the amount of sediment in oil. R. D. McDill, industrial electronics engineer, Cleveland, is the inventor of the unit, illustrated in Fig. 7.

The mechanism is composed essentially of a

photoelectric tube and a light source, by the combination of which the principle of the photocouple voltmeter is employed. In other words the voltage of the light source is measured by its intensity on the photoelectric tube by a millimeter in an amplifier circuit. The attendant has the instrument before him on the panel of the machine. Oil to be examined is placed in a cup shown on the panel forming the left section of the top. Through a tube it flows by gravity between the plates which are positioned between the vacuum tube and the source of light.

With the meter normally registering the full intensity of the uninterrupted light beam on the photoelectric tube, there is a decrease in the power registered when the beclouded oil passes between the glass panes. The light beam is intercepted in proportion to the amount of sediment in the oil. Interpreting the reading on the milliammeter in terms of sediment by arbitrary calibration, the attendant is able to estimate the condition of the oil and thereby approximate the probable causes of pollution. The tester is intended primarily for automobile service stations but may prove to be a boon in the diesel industry as well. In the latter case it has possibilities as an integral unit for indicating constantly the condition of the oil in the crankcase.

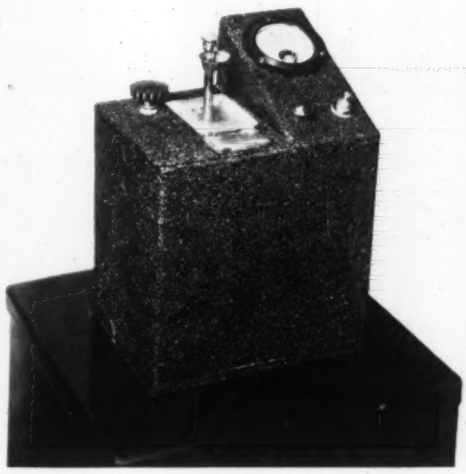


Fig. 7—Oil flowing between two glass panes is tested for sediment by a photoelectric cell

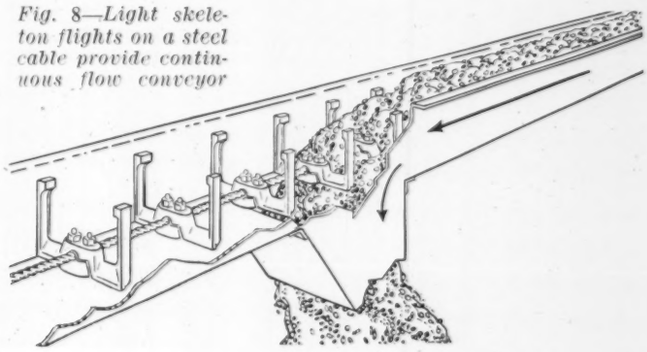
Putting Friction to Good Use

DISCOVERY by an English miller that two parallel conveyor chains pulled across the floor would move a whole bin of flour at one time revealed a new principle which resulted in a revolutionary system. Designers of materials handling equipment particularly will be gratified with the possibilities of this system which recently was introduced into this country. Bulk materials like soap flakes, grain, coal, starch, cement, sugar, cereals, etc. can be carried vertically, horizontally, up inclines and even around corners in a steady, undisturbed flow through enclosed steel or wooden troughs, Fig. 8. Transportion of materials apt to crumble always has been somewhat of a problem to engineers.

In its present form the conveyor consists of a series of light skeleton flights, closely spaced on a flexible steel cable or conveyor chain, which is pulled through a smooth trough. The unique conveying action is due to the fact that with practically all materials, it takes less power to pull a column of material through a smooth trough than it does to drag the flights through the same mass. These flights are U-shaped or H-shaped bars and float in the material.

Sidewall pressure and gravity are overcome in elevating the mass before the flights cut their way through the solid column of material. The continuous flow system is known as the Redler conveyor and Stephens-Adamson Co., Aurora, Ill., has been granted manufacturing and sales rights. Because it is compact and does not create dust, a disconcerting hazard from an explosive standpoint, designers will find the idea interesting.

Fig. 8—Light skeleton flights on a steel cable provide continuous flow conveyor



Why Not Side Bumpers for Autos?

WITH many of the new model cars incorporating valances on front and rear fenders more surface is exposed to scratches and dents, consequently some form of protection is desirable. The same thought applies in connection with the type of fender which has the headlight built into it. As a solution, side bumpers have been suggested.

To the present time only a few cars have their appurtenances guarded in this manner. Where the idea has been adopted the savings in fender costs and the preservation of appearance obviously justify the expense of installing the necessary guards. Any busy thoroughfare on a Sunday afternoon will prove the validity of the suggestion.

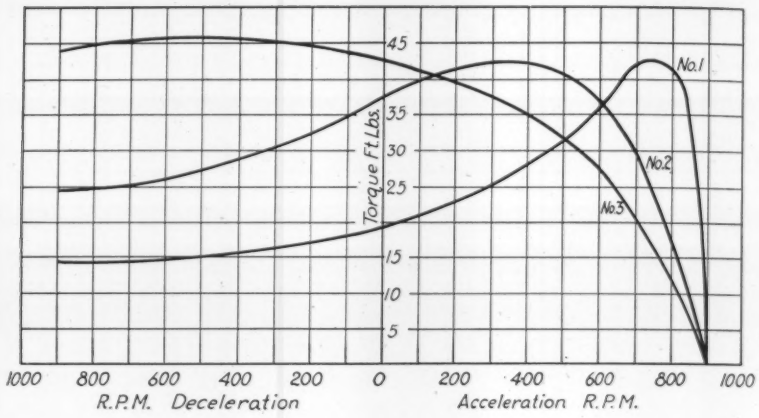


Fig. 1—Curve 2 represents the most favorable characteristics for the rapid reversing cycle

Selecting Motors for Specialized R

By R. J. Owen

ADVANCEMENT in motor design has kept pace with progress and development in power-driven machinery and has solved many drive problems faced by the machine builder. Outstanding improvements in machine performance have been accomplished through the selection of motors with electrical characteristics especially suited to that specific operating condition of the machine or various parts of machines.

Employment of squirrel cage induction motors was confined at one time to a somewhat restricted field of application which only included general purpose drives requiring constant speed and infrequent starting. However, there has been some remarkable improvements in squirrel cage motor design which have extended their use into many new fields on applications which formerly were considered impossible.

Frequent reversing or starting duty as required by tapping or threading machinery, lathes, planers, etc., is provided by squirrel cage motors with characteristics suited to the specialized requirements. Many of these machines have a continuous rate of reversal as high as 50 or 60 operations per minute, and a number have been redesigned to incorporate electrical reverse with exceedingly successful results. Built-in or direct mounted motors have transformed previous designs into self-contained reliable units with complete elimination of numerous mechanical parts formerly used for providing reversing or reciprocating motion.

The multiple spindle combination drilling and tapping unit, Fig. 7, is typical of this refinement in design, made possible through the use of a direct connected reversing motor. The maximum capacity of this machine is ten ¼-inch drills in cast iron which requires approximately 1 horsepower with all spindles in operation. The WR^2 or flywheel effect of rotating parts is practically negligible as they run at a slower speed and are comparatively lighter in weight than the rotor. A motor speed of 850 revolutions per minute is available for tapping, at which speed the motor has a capacity of 50 reversals or 25 complete tapping cycles per minute. For drill-

DESIGN too frequently has been handicapped by the inability to secure parts that will insure improved performance. Mr. Owen, engineer with Louis Allis Co., Milwaukee, points out how changes in squirrel cage induction motors have kept pace with other developments and thus permit design of more efficient machines.

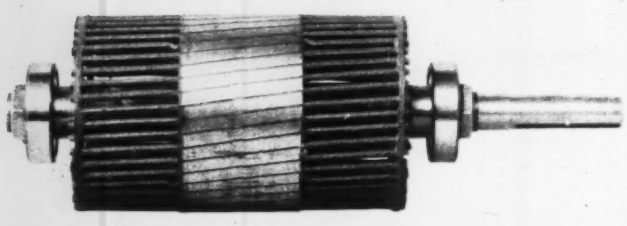


Fig. 2—Rotor construction consists of extended winding and large capacity ventilating fans

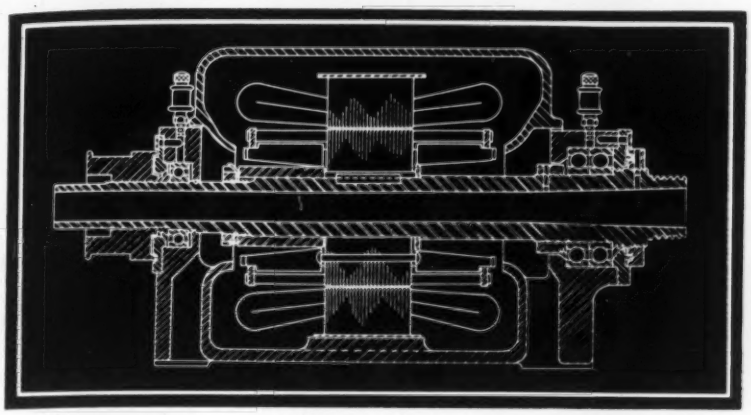


Fig. 3—Rolled shell type motor of shaftless construction has motor mounted directly on machine spindle

ed Requirements

ing service a second motor speed of 1750 revolutions per minute is available.

The reversing control consists of a standard reversing contactor operated by a 2-way lever type pilot switch actuated directly from the work table movement. This pilot switch is adjustable for upper and lower travel limits which provide facilities for accurate bottom-tapping. This arrangement gives positive forward and reverse with high sensitivity. Complete reversal of the motor takes place within a fraction of one revolution of the tapping spindles. The motor is a vertical, ball bearing type with low inertia rotor having the lower bearing bracket machined for end mounting.

Four Direct Speeds Available

A wider range of work of varying sizes is provided for in the sensitive drilling and tapping unit shown in Fig. 4 where four motor speeds are available in a 1 horsepower built-in motor with the rotor mounted directly on the spindle. Motor speeds of 1750, 1150, 850 and 550 R.P.M. supplemented by a back gear for lower speeds enable this machine to handle a variety of work. The motor is designed to reverse 20 to 30 times per minute and the torque at each speed is proportioned so that the time of acceleration is approximately the same for all speeds. The control consists of a built-in drum type speed transfer switch located at the back of the column together wth a toggle operated reversing switch actuated from adjustable stops on the spindle.

The reversing motors on both of these tapping machines have a modified rotor construction consisting of extended winding, Fig. 2, and large capacity ventilating fans. The rotor resistance in this case is proportioned so as to provide an increasing torque with a drop in speed, essential in a tapping application to carry over peak loads and also to facilitate bringing the motor up to speed in minimum time.

The alternating current squirrel cage motor has certain inherent advantages which make it especially suitable for fast reversing service. There are no insulated windings, end connections, or commutator forming a part of the rotating member to add weight or to become a source of trouble. The WR^2 effect of the rotor for a given horsepower and speed rating is approximately one-half that of the armature of a direct current motor of equivalent rating due to the employment of less active iron below the rotor slots.

With light weight rotor construction it is practical to reduce the WR^2 to a fractional part of that of the standard rotor which reduces the

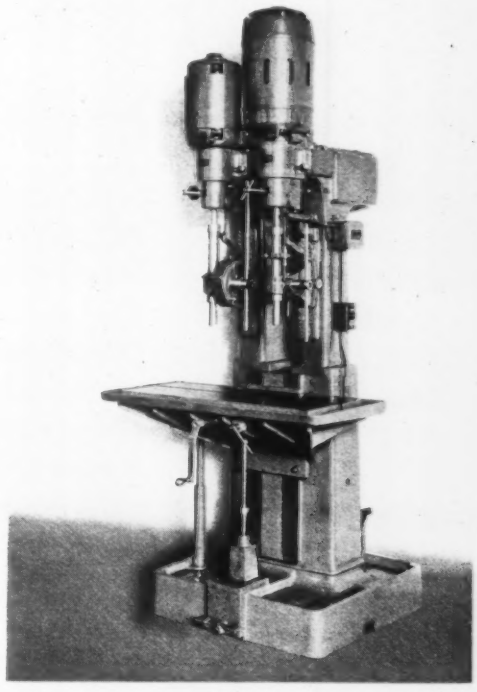


Fig. 4—Four motor speeds are available for sensitive drilling and tapping unit

losses and shortens the time of acceleration, leaving more torque available for carrying the load. In certain cases, it is practical to use a small diameter rotor but limitations in the electrical design will sometimes prevent this.

On most reversing drives the question of accelerating time and torque is important. The power required during the reversing cycle is divided into two parts: The energy absorbed to

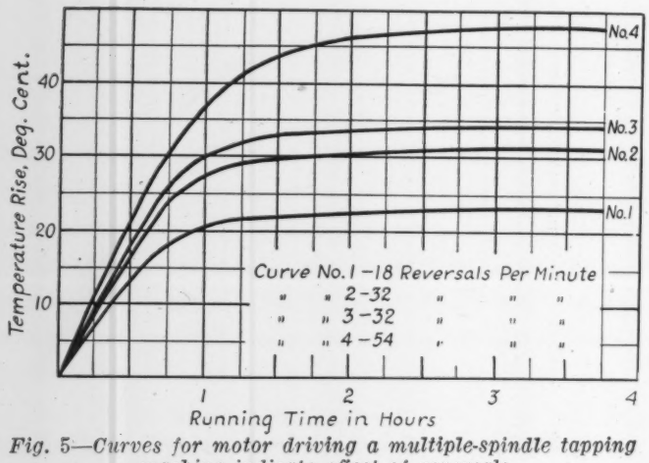


Fig. 5—Curves for motor driving a multiple-spindle tapping machine indicate effect of reversals

perform the operation with the motor operating at its normal speed and the energy required to accelerate and decelerate moving parts. Stored energy in a moving body is expressed as $WV^2/2G$, where W is weight, V velocity and G acceleration due to gravity. For a body having rotary motion this expression becomes:

$$Ft.\ Lbs. = WR^2 \times RPM^2 \div 5875,$$
$$\text{or } 0.00017 \times WR^2 \times RPM^2$$

It is evident that the energy in a rotating system is directly proportional to the total WR^2 effect and also the square of speed of rotation. Energy loss in the motor itself is influenced directly by WR^2 of the drive and final speed both of which should be reduced as far as practical for best results. If the greater part of the WR^2 effect of the drive is concentrated in the rotor it is advantageous to use a motor having a slow speed, while on the other hand if the majority of the WR^2 effect is due to other rotating parts it is more desirable to use a higher speed motor with a means of speed reduction.

Torque in foot pounds required to accelerate a rotating system to a given speed is

$$Torque = WR^2 \times RPM \div 308 \times t$$

where

WR^2 = weight times radius of gyration in pound foot units
RPM = ultimate speed of rotation
t = time in seconds for acceleration

It is assumed in this expression that the accelerating torque is constant throughout the time of acceleration. The time required for acceleration under a given set of conditions is determined by

$$t = WR^2 \times RPM \div 308 \times average\ torque$$

In calculating time and torque values for a specific application by this method, the WR^2 must include all of the rotating parts in the system. Where the rotating parts of the driven machine have a different speed than that of the motor, it is necessary to convert their WR^2 to the basis of motor speed. This conversion is

$$Load\ WR^2\ with\ reference\ to\ motor\ speed = \left(\frac{motor\ RPM}{driven\ RPM}\right)^2 \times WR^2\ load$$

With the total WR^2 of the system and the load characteristics known, the required torque for acceleration up to final speed in a given time can be determined accurately. This torque is directly proportional to time of acceleration.

When the speed and WR^2 of the drive have been determined it is necessary that a motor be selected having the proper speed torque characteristics. For a fast reversing cycle the ideal condition would be where the motor would deliver the same torque at any speed from zero up to operating speed and back to full plugging speed in the opposite direction, but as such a condition cannot be attained in a squirrel cage machine, the selection necessarily must be made on the basis of average torque. A comparison of typical speed torque curves of motors with different characteristics will indicate which is the most desirable from the standpoint of a high average torque to accelerate in minimum time.

In Fig. 1 showing typical speed torque curves of three types of squirrel cage motors, curve 1 indicates a standard low resistance rotor, while curves 2 and 3 show the effect of successively higher resistance rotor windings. By computing the average accelerating torque in each case, it will be found that curve 2 represents the most

TABLE I

Comparison of Average Acceleration Torques of Three Types of Motors

		Change in Speed										Average
Curve No.		0 to 85	85 to 170	170 to 255	255 to 340	340 to 425	425 to 510	510 to 595	595 to 680	680 to 765	765 to 850	Torque & Time
1	Torque	20.5	22.0	23.5	25.5	28.0	31.0	34.0	38.5	42.0	38.0	28.6
	Time	.27	.25	.235	.217	.194	.18	.16	.143	.13	.145	1.924
2	Torque	38.5	40.0	41.5	42.0	42.5	41.5	39.0	34.5	27.0	16.0	41.5
	Time	.143	.138	.135	.13	.13	.135	.14	.16	.204	.34	1.655
3	Torque	42.0	40.5	39.0	37.0	35.0	33.0	29.5	24.5	18.5	10.5	26.0
	Time	.13	.136	.14	.15	.16	.167	.187	.225	.30	.526	2.121

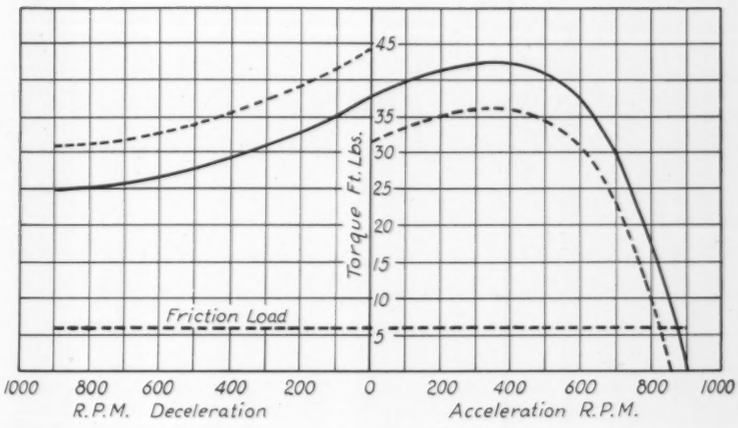


Fig. 6—Friction load is assumed constant at all speeds in determining available torque for acceleration

favorable characteristics for the rapid reversing cycle. The average torque value is taken for each of ten equal speed steps and acceleration time calculated.

A comparison of average accelerating torques of the three types of motors is given in Table 1 where the final motor speed is 850 R.P.M. and the WR^2 is assumed to be 20. The influence of the shape of the speed torque curve upon average torque and time required for acceleration is obvious.

Average torque for deceleration also must be considered if the full reversal is to be completed in minimum time. Referring again to Fig. 1, the curves have been extended to show torque available for deceleration with curve 3 having the highest value, indicating that this motor will stop a given load quicker than either curve 1 or 2. A further study of these curves, particularly 2, will show that starting torque should be equal to or slightly less than maximum torque. This relation is subject to variation to obtain best results under different driving conditions and will depend upon the operating cycle and final speed. The shape of the torque curve can be varied to meet different load conditions by a change in resistance of the rotor winding.

Friction Load Assists Motor

In the equation showing the relation of WR^2, speed, torque and time for acceleration and deceleration, the torque for driving the load and overcoming friction has not been considered. Available torque for acceleration will be the motor torque minus the friction and load torque present during acceleration. Fig. 6 shows this condition for acceleration with the dotted curve indicating net torque for accelerating, and the full line curve the motor torque. In this case the friction load represented by the horizontal line is assumed constant at all speeds. This friction load assists the motor during deceleration and, therefore, the net torque available for stopping will be the sum of the motor torque and that due to friction in the drive. It is clear that the average torque for deceleration will be much higher than the average torque for acceleration, and consequently the time of deceleration will be less. The friction load also has the effect of increasing the losses in the motor during acceleration and decreasing them while decelerating. In selecting motor capacity, a factor of safety is necessary to cover a possible variation in the friction load such as added bearing friction, windage, etc., which may increase the calculated torque from 25 to 50 per cent over estimated values.

A number of important facts are brought out by a consideration of the several factors which affect losses in a motor operating on a fast reversing cycle. These are:

(a) Total losses in the motor vary directly with the square of the ultimate speed and it is, therefore, important that the speed of all rotating parts of the drive be held to a minimum.

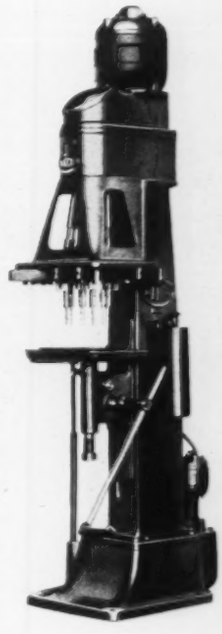


Fig. 7—Direct connected reversing motors permit refinement in design

(b) Losses are proportional to the total WR^2 of the drive and it follows that the lower the WR^2 of both the rotor and load the more efficient the drive.

(c) Size or thermal capacity of the motor will be influenced by the character of the cycle of operation, i.e., the proportion of the time the motor runs at rated speed compared to the time for acceleration and deceleration.

This last factor is the most important aside from the average torque which also affects determination of the size of motor frame. The time during which the motor operates at rated speed is effective cooling time during which heat produced by the losses of acceleration and deceleration is dissipated. Time during which the motor is stopped is not nearly as effective as running time in dissipating these losses.

From actual test data it is demonstrated that

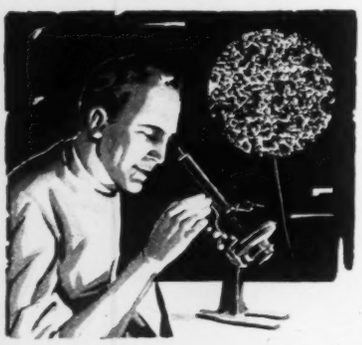
(*Concluded on Page* 56)

Research Is Key to Progress

Narratives Reveal How Invention and Discovery Have Aided Humanity

BEHIND virtually every engineering invention or discovery is a story which might be referred to more technically as a research narrative. The welding of electric street railway rails, for example, led to the construction of a large rotary converter, probably the first one of magnitude. Now such machines for changing alternating to direct current and vice versa are common equipment in power stations and manufacturing plants.

This solution of a welding problem seems on the surface quite casual, but the action that went on behind the scenes is one of singular engineering romance. The spotlight is directed on Hermann Lemp, a prolific inventor who first heard the name of Edison in his native Switzerland, saw the latter's first steam-driven dynamo in Paris in 1881, and before the end of the year was on his staff at Menlo Park. Six years later he joined the Thomson-Houston Electric Co., and was asked by Prof. Elihu Thomson and E. W. Rice to devote all his time to the development of welding. While working on the problem of providing alternating current from a direct current trolley wire the "happy thought" which



took the form of a rotary converter came to him "like a flash."

Other developments have similar records, some involving accidental discoveries which led to great achievement, and others that were the inevitable result of long tedious search in quest of a definite end. Regardless of their origin and evolution each one has a story and thanks to Alfred D. Flinn of the Engineering Foundation these incidents have been collected and preserved in the form of brief *Research Narratives*. It was in 1921 that a start was made in printing the various subjects in lay language. To date three volumes are available, each containing fifty narratives written by men who took a prominent part in the development described or prepared from data furnished by them.

No tribute to *Popular Research Narratives* better expresses the thought behind their compilation than that written by the late John J. Carty, distinguished engineer, inventor and leader in research. He saw in these stories more than scientific reading in an entertaining and instructive manner. They constitute, he said, a distinct contribution to the cause of scientific research because they present to the reader in authentic form concrete examples of the methods, vicissitudes and triumphs of scientific research.

Laboratory Plays Important Part

When Dr. Carty wrote that, he viewed the entire collection of narratives. In this brief review it is impossible to abstract or discuss even a portion of them, but reference should be made as an example to one which brings out what is happening on the other side of the laboratory door. This concerns aluminum plating and is the concluding narrative of volume three.

Attempts made to electroplate aluminum by methods common to practice with other metals proved unsuccessful. Platable metals do not perform alike, and aluminum appears to be emphatically non-conformist. Systematic research was undertaken in 1927. For one experiment it was necessary to cool the reaction chamber by means of ice to about 20 degree Cent. In another experiment the temperature necessarily was maintained at 100 degrees Cent. by an oil bath. Both processes were successful. A new method also may overcome difficulties in plating with titanium, tungsten, chromium, beryllium, tantalum and still other metals, the authors of this narrative observe.

It will be seen from the foregoing brief review that *Popular Research Narratives* are issued to bring to light the importance of organized research. The three volumes may be obtained from the Williams & Wilkins Co., Baltimore, or through MACHINE DESIGN for $1 per volume, plus 10 cents each for postage when ordered singly or 15 cents postage for the set.

Fig. 1—Dual requirements of strength and conductivity are satisfied by alloy spring

Beryllium Copper Challenges Existing Materials

By C. H. Davis

ALTHOUGH it has only been within the last few years that beryllium has been produced in quantities sufficient to allow careful study of its properties, numerous fields have been considered and many applications selected where beryllium copper, the most recently introduced alloy of copper, will be more efficient than materials now used. The alloy is mainly copper with a small addition, up to 2½ per cent, of the element beryllium found chiefly in the mineral beryl of which it constitutes approximately 5 per cent.

Without heat treatment the material compares favorably with other nonferrous alloys and is superior to the bronzes ordinarily used in electrical equipment. The electrical industry also finds sheets and strips, available down to about 0.005-inch thickness, of particular value. In a test still in operation by an electrical company, a beryllium-copper spring used on a small circuit breaker has made over 8,000,000 starts at the rate of 33 1/3 per minute without any sign of failure or change of condition. During full speed operation the spring carries between 0.3 and 0.5 amperes and is compressed at the approximate rate of 25 times per second. The long narrow spring of the material shown as part of the distributor in Fig. 1 satisfies the dual requirements of strength and electrical conductivity. A double spring of steel and copper was used previously.

Springs for automatic telephones, motor brush holders and similar applications, where electrical conductivity as well as high resistance to continuous alternate stress is a factor, have been made of the material. In these applications beryllium copper replaces bronze springs. Helical springs have withstood as many as 3,000,000 compressions. The resistance of the material also has been demonstrated in a number of additional ways. The alloy in the form of diaphragms gives excellent service as borne out by laboratory fatigue tests.

Annealed wires of the smaller sizes may be woven into cloth and subsequently heat treated. Such cloth then becomes stiff and strong, since the tensile strength of the individual strands will be in the neighborhood of 140,000 to 160,000 pounds per square inch. Rods may be machined automatically into finished parts employed wherever great strength, hardness, resistance to compression, and like qualities are required. Large rods and wire down to 0.010-inch are being manufactured.

Can Reduce Weights of Parts

High unit strength of the alloy makes it possible to reduce the weight of gears, pinions and cams. Savings in weight are due more to increase in strength than to lower density. The specific gravity at 2 per cent beryllium is 8.28; at 2¼ per cent beryllium, 8.20. As beryllium copper presents a hard wearing surface, it is especially applicable for use as valve guides and similar parts.

Tubes have been made in most commercial sizes, although not in large quantities. One of the principal uses is the cold drawn Bourdon tube employed in the manufacture of pressure

EXTENDED service results on parts manufactured of beryllium copper are not as yet available, but present applications and laboratory investigation indicate that the alloy has wide possibilities as a design material. Mr. Davis is in the technical department of American Brass Co., Waterbury, Conn. Future articles on this material will deal with new uses as they are brought out by further application.

gages. This tube is shown in Fig. 3.

There has been no service experience with bearings as yet, but wear tests are underway. The alloy possesses a crystalline structure apparently suitable for bearings. A. bearing should

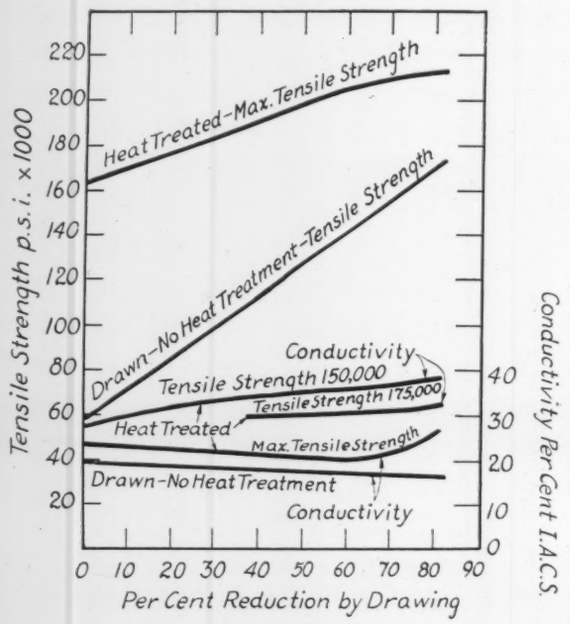


Fig. 2—Either cold drawing or heat treatment will improve the strength of beryllium copper wire

have a low coefficient of friction, sufficient hardness to carry the service loads, yet have the property of taking a high polish on the bearing surface as the lubricating film becomes thinner under increasing loads. Beryllium copper appears to have these properties together with good resistance to corrosion. Brinell hardnesses of from 250 to 380 are obtainable with the 2¼ per cent beryllium alloy heat treated.

Physical Properties Raise Value

Because of the present relatively high cost, the effort to introduce this new copper alloy may be questioned. The answer to the cost objection is to be found in the physical properties, not only in the cold rolled or cold drawn condition, but more especially in the heat treated state. Its chief advantage lies in the fact that it can be fabricated in the soft annealed state and then heat treated to improve its physical values tremendously.

When either the annealed or cold wrought beryllium copper is subjected to low temperature treatment from about 275 to 300 degrees Cent. for a period of two hours the strength, hardness and allied properties are improved greatly. For example, the tensile strength of annealed beryllium copper will be increased by heat treatment from about 60,000 to 160,000 pounds per square inch; hard rolled sheet would increase in like manner from 165,000 to 210,000 pounds per square inch. By the same treatment the conductivity is increased by 2 per cent or more of the International Annealed Copper Standard. The elastic limit and modulus of elasticity likewise are affected beneficially.

Fig. 2 illustrates how cold drawing improves the strength of beryllium-copper wire, and in the uppermost curve how the same wire is improved by heat treatment, the treatments ranging as before from 275 to 300 degrees Cent. for about two hours. It may not always be desirable to attain the maximum tensile strength or hardness, so by intermediate or shorter heat treatments lesser strengths and hardness may be secured with corresponding improvement in percentage elongation and ductility.

May Be Welded Easily

Beryllium copper may be welded by means of the carbon arc or metal arc using a filler rod of the same composition, or silicon-copper welding rod. Such welds may be peaned, annealed and then heat treated to develop a strength of well over 100,000 pounds per square inch. Electric spot welding has been done on a commercial scale. Successful gas welding awaits the development of a proper flux.

The alloy may be hot forged or hot pressed readily at temperatures between 720 and 820 degrees Cent., depending upon the beryllium

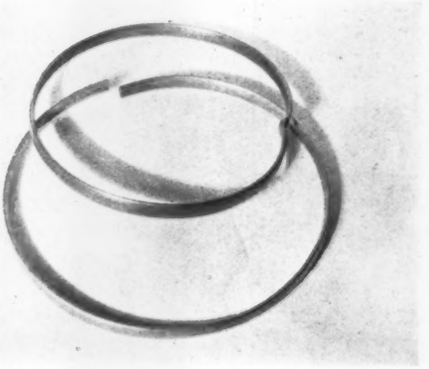


Fig. 3—Cold drawn Bourdon tubes may be manufactured from the alloy

content. After hot forging the part is annealed at 800 degrees Cent., quenched, and heat treated at 275 to 300 degrees Cent. The brinell hardness then will be about 350 and the tensile strength about 150,000 pounds per square inch.

Other factors to be considered in the application of the material are that it can be brazed, silver soldered or soft soldered readily. Beryllium copper is not free cutting but it is not difficult to machine; the alloy is tough, however, as would be expected from its physical properties. It nickel plates easily and a chromium plate has been successfully secured over the nickel plate.

Careful Research Obviates Patent Pitfalls

By George V. Woodling

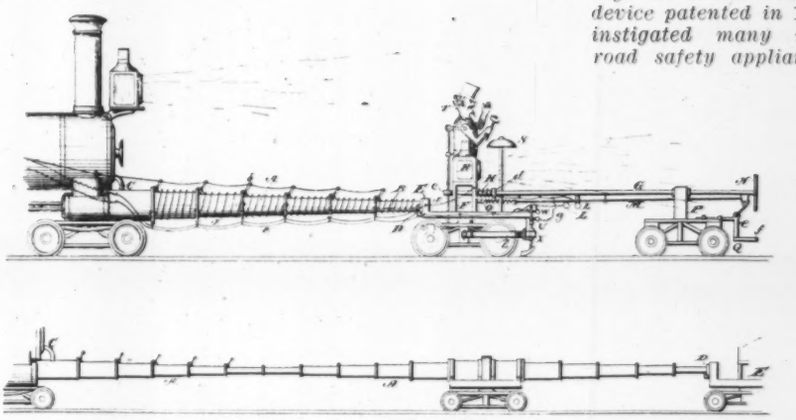


Fig. 1—Train control device patented in 1880 instigated many railroad safety appliances

ATTEMPTS to design around adversely-held patents begin immediately when the pioneer invention is tossed into the public arena. From this moment the contest never ceases. Each subsequent inventor, as he enters the field of development, not ony tries to avoid the claims of the prior unexpired patents but also endeavors to develop a better and more salable article than those developed by the prior inventors. The obvious effect of this is that each step forward prepares the way for the next and thus causes a rapid accumulation of the so-called improvement inventions.

In this connection attention is called to the thousands of improvement inventions that must of necessity lay, for instance, between the pioneer apparatus for preventing collisions of railway trains shown in Fig. 1 and the modern train control equipment, Fig. 3. To the modern world, this pioneer device may appear crude and totally impractical and yet it is such pioneer inventions, produced by individuals, that start the ball rolling. Contrary to the general opinion it is interesting to note that usually the engineers employed by the large corporations have made comparatively few pioneer inventions, but that most of the epoch-making inventions have been produced by the individual inventor and later developed by large corporations.

An inventor may, if he so desires, keep his invention a secret. In many cases the exploitation of an invention under a secret process may prove extremely profitable to the inventor. This is particularly true where the nature of the invention is such that the form in which it is sold to the public does not disclose, to those skilled in the art, the manner in which it is constructed or compounded. The obvious effect of such a method of exploitation however, would be to stifle the progress of science. To overcome such conditions is the very purpose of the patent laws. In effect, the law says to the inventor, if you will disclose your invention to the public the government will grant you a patent which gives you the exclusive right to make, use, or sell the invention for a period of seventeen years.

Copyright, 1933, George V. Woodling

Should Investigate Rights

In view of the many unexpired patents it is advisable before exploiting an improvement invention to investigate the patent rights of other inventors. These rights may be determined by conducting a search of the records in the Patent Office to ascertain whether there are any unexpired patents relating to the proposed device. The patents collected in the search then are analyzed and studied with a view to determining whether or not the manufacture, use, or sale of the proposed device constitutes an infringement of any of the claims of the patents. In making such an analysis many delicate and doubtful questions arise.

Just what stand the exploiter, through his patent attorney, should take in deciding these doubtful questions cannot be answered readily without knowing and weighing all of the facts of the case. Other things being equal it generally is advisable for the exploiter to resolve any questions of doubt against himself, for the reason that a successful plaintiff in a suit on a patent may be awarded damages as well as the profits of the defendant. This is particularly

true where a judgment of a court is collectable against the exploiter. Where the proposed device is a "chinese copy" of an unexpired patented device there is little hope of avoiding an adverse decision. Moreover, in such cases where the defendant has willfully and knowingly infringed with a view to damaging the business of the plaintiff, the court, at its discretion, may assess punitive or exemplary damages up to three times the actual damages.

It has been held in some cases that where an officer of a company has been particularly active in the infringing operations of this company he may be held personally liable for a part or all of the damages. Therefore, an exploiter when weighing the question of noninfringement, should not feel too optimistic. His attitude should be that of a "constructive" pessimist. In keeping with this attitude, the exploiter will be inclined first to develop a clearly noninfringing design and second, if this is impossible, to negotiate for rights under adversely-held patents in order to avoid costly litigation.

There is considerable value in ascertaining the state of the patented art before entering upon an important development or before exploiting a new device. In the first place, it will enable one to purchase adversely-held patents at a reasonably low figure because, after development actvity is once started by the exploiting company, the value of such patents is greatly enhanced. In the second place the purchase of outstanding patents will afford immediate protection and will tend to discourage infringing competition.

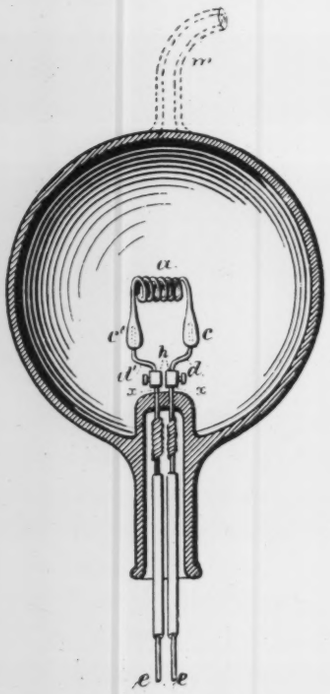


Fig. 2—Thomas Edison was allowed claims for his incandescent lamp even though the only change he made was in the size of filament

Not unlike an individual, the government is interested in obtaining adequate consideration for the contracts that it enters into. Therefore, before the government will grant a patent, which is in the nature of a contract, it makes sure that the invention for which the patent is granted is worth while and one that promotes the progress of science. To this end Congress has passed certain patent laws which enumerate the classes of inventions for which the government will grant patents. These classes include any *new* and *useful* art (process), machine, manufacture or composition of matter, or any new and useful improvement thereof; or any *new* and *ornamental* design for an article of manufacture; or any *new* variety of plant asexually reproduced, except a tuba-propagated plant. Therefore, unless an invention falls within one of the above mentioned classes it is not patentable and immediately upon disclosure becomes public property.

In the patent language the terms "Art" and "Process" are used synonymously and may be defined as a connected series of steps or operations for accomplishing a *physical result*, and not for accomplishing a mere *abstraction*. The physical result, however, need not be a permanent condition of the article or substance acted upon, but may be temporary as, for example, in the case of transmitting speech by certain regulated undulations of the electric current in the telephone.

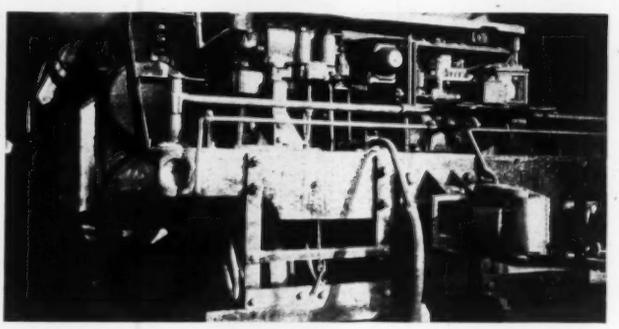


Fig. 3—Modern control for stopping trains automatically employs electronic equipment

Attempts have been made to obtain patents for a method of doing business upon the ground that it is a process, but the courts have held that mere mental theories, ideas or the method of doing business is not a process for the reason that they do not accomplish a physical result.

Cannot Claim Natural Powers

The courts also have held that the discovery of abstract principles, or what is called a "law of nature," is not patentable because patents are grantable only for the creation of something which did not exist previously and not for the revelation of something which exists but was unknown. There is another reason, and that is that no one can claim to the exclusion of everybody else a right to the powers of nature. A striking example of an attempt to claim a power of nature is the case in which Samuel F. B. Morse, the inventor of the telegraph, claimed in his patent the use of the motive pow-

er of the electric or galvanic current, however developed, for making or printing intelligible characters, letters or signs, at any distance. The Supreme Court held such a claim to be void, as it claimed a power of nature.

Not all improvements possess the dignity of invention. Some of them do not rise above the creative level of mechanical skill, and thus are not patentable because the government is interested only in granting patents for things that truly promote the progress of science. The plane which separates invention from mechanical skill is at best a thin one and thus is difficult to define, since every case must lie either above or below the thin dividing plane. Then, too, this difficulty is enhanced by reason of the fact that we must, of necessity, look upon the question of invention with eyes taught by the ingenuity of the thing created.

The courts generally are guided in deciding questions of this nature by the facts and circumstances surrounding the invention taken in the light of several negative rules that they apply for testing the presence or absence of invention. Since these rules operate by a process of exclusion they state what is not invention rather than what is invention.

Vague Idea Not Sufficient

Thus, merely to perceive the end desired or the need of something is not invention. There must be something more than vague notions of how a certain thing may be accomplished.

Nor is it ordinarily invention to cheapen the cost of an article by simplifying its construction, or to produce a new article which differs from some older device only in excellence of workmanship because such changes are merely due to mechanical skill. However, the fact that an invention is small and simple requiring no high degree of imagination does not negative invention so long as the invention achieves a distinct advance in the art.

Aggregation is not invention. An important legal distinction exists between a combination, which is patentable, and an aggregation, which is not. In a combination the assembled parts of a device co-operate to produce a joint function, whereas in an aggregation the assembled parts do not co-operate but operate independently to produce nothing more than the summation of the separate parts. The United States Supreme Court held that an ordinary lead pencil having an eraser on the end was an aggregation on the ground that there is no joint operation performed by the pencil and rubber.

Unless a new and unexpected result is accomplished it is not invention to substitute superior for inferior materials or to enlarge and strengthen a machine so that it will operate on larger materials than before, because such changes involve nothing more than judgment and skill in selecting and adapting the proper materials and parts to a definite purpose. Nor is it invention to change the size or degree of a thing unless such change results in a new mode of operation.

A striking example of how a change in the size of a part may amount to invention is illustrated by a simple change that Thomas Edison made in the incandescent lamp shown in Fig. 2. He merely reduced the diameter of the filament by one-half of its original size. This reduction produced a new mode of operation. It reduced the electrical resistance fourfold; the radiating surface twofold; and hence the ratio of resistance to radiating surface eightfold. This change alone gave incandescent lighting its present standing in the world. It is essential, however, where the invention consists of a change in the size or degree of a thing that there be a definite standard established to distinguish the invention from prior devices.

New Use Not Patentable

As a general rule it is not invention to make a device portable or to use an old device for a new and analogous purpose. Whether or not the new use is analogous must be determined by comparing the facts in each case. Nor is it invention to duplicate or omit one or more parts of a device unless the duplication or omission of the parts causes a new mode of operation.

Obviously, the foregoing rules do not cover all of the cases that may arise, but they are illustrative and serve to give the reader a general idea of exactly what constitutes invention.

For an invention to be patentable it must be new and useful. It is remarkable, nevertheless, how many devices are reborn generation to generation. While an invention may appear to be entirely new there is always a possibility that substantially the same general idea had been thought of before. This is particularly true where the invention resides in a

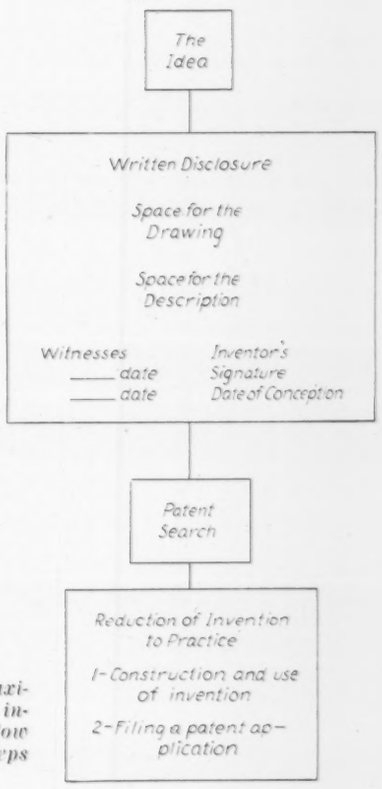


Fig. 4—To secure maximum protection the inventor should follow these fundamental steps in development

crowded art. Not infrequently an idea is born before its time and languishes in obscurity for many years because the world is not ready to accept it. Such an invention is the electric motor patented by Thomas Davenport in 1837, Fig. 5.

The best way to determine whether or not an idea is new is to conduct a search among the patent files at Washington. The advisability of conducting a patent search before filing a patent application or before undertaking development activity depends to a large extent upon the nature of the invention and upon whether

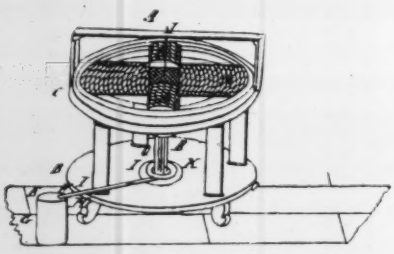


Fig. 5—Many inventions, such as the electric motor patented in 1837, are devised before their time and languish in obscurity

or not the invention resides in an old and overworked art. However, by reason of the fact that all pending patent applications in the Patent Office are held in strict secrecy, a patent search does not disclose whether or not another inventor has a patent application pending upon the same subject matter.

Should the search reveal a patent which shows and describes the same idea, then that patent is said to "anticipate" the new idea. Also, printed publications such as trade magazines, technical books and catalogs, both foreign and domestic, may constitute an anticipation if that publication shows and describes the same idea as the new invention. However, novelty is not negated by a previous foreign use of the invention because it is only public use in this country that constitutes a bar to grant of a patent.

Anyone May Obtain Patent

The law imposes no restrictions as to who may obtain a patent, except against the employes of the United States Patent Office. Therefore any person, no matter whether the inventor be a citizen of a foreign country, a woman, a minor or the administrator of an estate of a deceased inventor, may obtain a patent so long as the invention is a patentable one.

In determining a question of priority of invention between two or more inventors claiming the same invention, each inventor is called upon to prove when he first conceived the invention. In such cases, as in all contests, it is difficult to prove facts such as the date of conception, by oral testimony. Therefore, to avoid the risk of replying upon oral proof an inventor should prepare a written disclosure of the invention as soon as possible. Lapse of time may result in a failure to make a written disclosure and may also lead to uncertainty as to the date of the invention and the surrounding circumstances. The disclosure should be as complete as practicable. As a convenience, the following outline is suggested.

1. Drawing

   The drawing should show all of the essential features of the invention. While a rough sketch of the invention will suffice, the drawing should be fairly well executed.

2. Description.

   The description should be as complete as possible and should include a description of the invention with reference to the drawing, and the manner in which the invention operates.

3. Signatures.

   The disclosure, in order to be complete, should bear the signature of the inventor, the date of conception, the signature of at least one witness and the date that the witness signed the disclosure. If there is more than one inventor they should all sign the disclosure. It is preferable to have more than one witness and, further, they should be capable of understanding the invention. It has been held that a disclosure by an inventor to his wife was insufficient. It is highly important that this disclosure as well as all other sketches, models, letters concerning the invention and purchase orders for materials in making the model be preserved. The first rough sketch made at the moment the idea first occurred is destroyed all too frequently.

4. Searches.

   As previously stated, the advisability of conducting a search depends upon the nature of the invention and upon whether or not the art in which the invention resides is overworked. Usually, if the inventor is well versed in the art, a search is not necessary. In those cases where a considerable amount of development is necessary to perfect the invention, a search is of considerable value because the development may begin where the art left off. In this manner overlapping of developments is avoided.

5. Reduction of Invention to Practice.

   An invention may be reduced to practice in either one of two ways. One way is to embody the invention in such form as to render it capable of practical and successful use. This is called actual reduction to practice. The other way is to file a patent application of the invention in the United States Patent Office. This is called *constructive* reduction to practice.

Lack of Diligence in reducing an invention to practice, either actual or constructive, may defeat the rights of an inventor. The patent law allows an inventor a reasonable length of time to reduce his invention to practice, but if he fails to do this his rights may be legally defeated by a subsequent inventor.

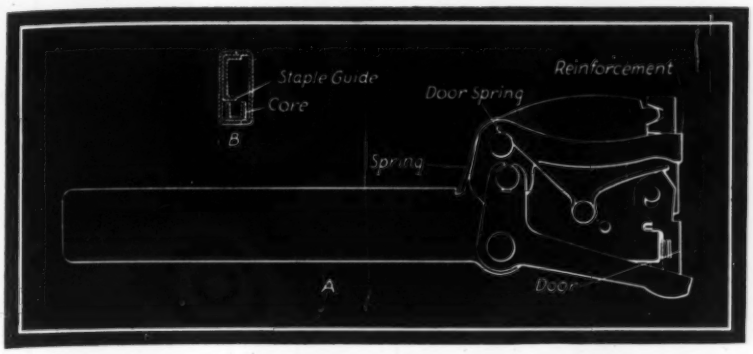


Fig. 1—Striker member in automatic hammer accelerates the driver movement

Varied Use Governs Design of Automatic Hammer

By J. F. Cavanagh

Research Engineer, Boston Wire Sticher Co.

TWO distinct functions are required of an automatic hammer—feed and drive. The feed usually involves the loading of tacks into a slide provided with a spring which keeps them under a forward pressure, while the drive consists of a driving unit having a relatively up and down motion. All attempts heretofore to design a mechanism for the latter have come under two broad principles of operation called inertia drive and positive drive. Inertia devices take the form of a weighted driver slidably or pivotally mounted in a comparatively light handle and develop sufficient kinetic energy in the swing to drive the tack home after the housing member comes to rest against the work. The positive drive has been more satisfactory in operation but structural difficulties made it troublesome.

Initial steps in the development of the hammer discussed in the following were: An examination of the few automatic hammers which have been marketed along with a study of the claims of issued patents in order to avoid entering upon a phase of development which might go for naught, and a careful investigation of uses to which the device would be put. This latter phase of the preliminary work resulted in a wealth of information covering the requirements of an ideal hammer which most effectively would meet the widely diversified demand. The investigation pointedly established the fact that designing a hammer for light work of unvarying character such as tacking tags on soft pine packing cases in the hands of an intelligent clerk is quite different from producing a hammer which will stand up in the hands of a robust railroad man who must line a box car with paper in five minutes and who will not tolerate any difficulties arising from contact with hard dry wood or even imbedded nail heads. As the investigation proceeded it became increasingly plain that a successful hammer must embody definite inbuilt qualities in order to avoid prohibitive servicing.

These considerations finally resulted in an imposing list of prohibitions and for several months made the ultimate perfecting of the design seem remote. Reference to a few of these considerations will make plain the difficulties. Attaching tags of freight cars passing an operator at the rate of about five miles per hour in zero weather calls for instantaneous loading with gloved hands. Tagging frozen fish in a refrigerator re-

(*Concluded on Page* 58)

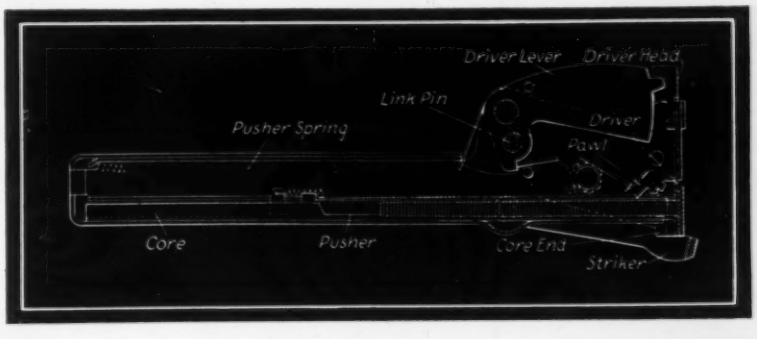


Fig. 2—Pawl, put into action only when door is opened, prevents the staples from flying out under spring pressure

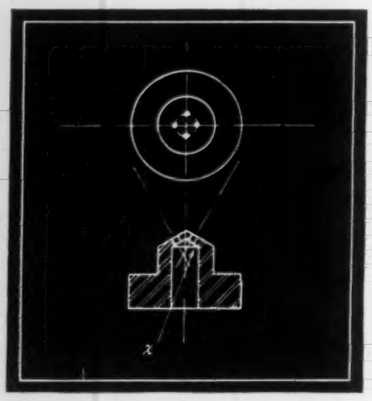


Fig. 1—Density of original part dulled the drill, heat treatment eliminated the difficulty

Considering Design from th

By Harold F. Shepherd

FREQUENTLY the details of a design, inadequately considered, are the source of unwarranted trouble and cost in production. When operations such as drill, bore, ream, grind, hone or lap are specified with dimensions and tolerances they should be selected with due study. Costs and results are involved in the choice. When the bores are threaded the advice to tap, chase or mill requires equally serious consideration.

Much processing and dimensioning is evolved by the system of passing the buck to junior detailers and even to tracers. Naturally the executive cannot supervise every item of shop instruction placed on drawings but he can establish rules and guide the men in the designing of parts best adapted for production on the tools for machine building. A better knowledge of these tools is of inestimable value to the designer.

Should Analyze Twist Drill

Even the familiar twist drill deserves analysis. All small drills and long drills of moderate size are potentially unstable columns, especially when slightly dulled. Breakage of small drills is not necessarily the result of abuse or carelessness but rather their usual fate when called on for severe duty.

Materials are annealed for almost every cutting operation except drilling, yet in this case no control over the dimensional strength of the tool is possible. For small operations annealing always should precede drilling, especially for machined work since metal may be cold worked ahead of the tools used previously. In the rose, Fig. 1, the metal at x was so dense that it dulled the drill or caught it as it cut through. Heat treatment of the part before the last operation eliminated all difficulties.

It is inhuman to require the shop to put a ¼ or 5/16-inch hole through several feet of solid steel at the whim of a draftsman, when a larger and stronger drill might serve. Where deep drilled holes are used for passages, as in Fig. 4, it is advisable to use a large drill and reduce the hole with a tube located by washers welded in place.

Taps also are highly stressed tools, particularly those of the bottoming variety which form a thread at one cut. Consequently it is well to order stud holes drilled two diameters in depth wherever possible so that plug taps may be used exclusively even though studs are driven but one to one and a third diameters. It is best also to establish two standards for tap drills. Tap holes in steel drilled for three-quarters of the full thread are advisable since the metal burrs up to fill the thread, and the cutting torque remains well within the ordinary capacity of the tap. For other metals drilling for full thread may be in order.

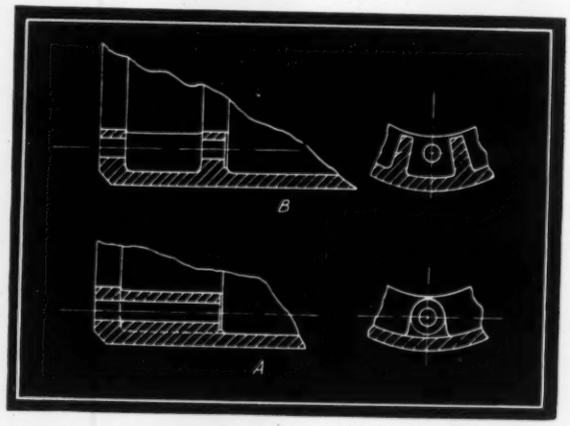


Fig. 2—Design may be corrected as at B to eliminate need of drilling a series of long parallel holes

Drilling with a two-lip drill is not a generating process. One end of the drill follows its point, which may wander. Therefore it is not reasonable to expect ease of assembly from interdependent drill press operations unless intelligent consideration is given to the effects of inherent errors. Such assemblies, often economical, should be studiously self-aligning.

Not only the drill but the machine itself merits study. A radial drill is indispensable in modern manufacture but no engineer should require it to drill a series of parallel holes, Fig.

om the Production Standpoint

Part IV — Holes

2*A*, normal to a surface by virtue of the machine's alignment. Modern radials are rigid but old ones well loaded may drill off.

If the allowable expenditure on the operation prohibits drilling on a horizontal boring machine or post mill on account of time lost in less rapid maneuvering or if the quantities prohibit a way drill the design may be corrected with benefit as in Fig. 2*B*.

Although there seems to be no adequate reason for the belief that the work must turn rather than the tool for accurate deep hole drilling or trepanning, our machines to date require severance of deep hole operations into dimensions within the swing of gun and rifle lathes which possess:

Practically perfect and fixed agreement of work and tool axes

Means of shortening the projection

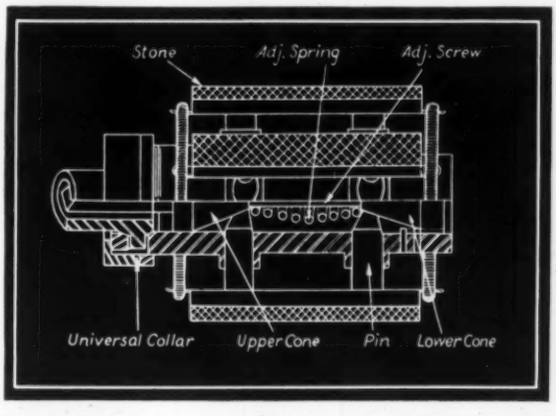


Fig. 3—Hone carriers are elastic enough to permit entering bore with a bite at high spots

of drill so that it bores its way for a true start

No necessity to project the entire drill length until required, the drill being lengthened or extended through its carrier as the hole deepens

Use of cutting tools usually of the single lip type having no tendency to cut or scrape their bearing in the hole

If homogenous material is provided and carefully annealed, deep drilling operations

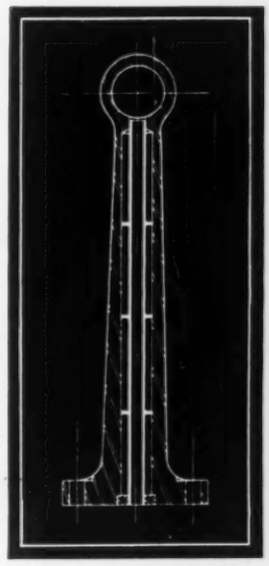


Fig. 4—Larger holes reduced by washers holding a tube permit simpler and faster production

may be conducted with as little as 1/32-inch runout in ten feet.

Boring, particularly with the single tool or fly cutter, is a generating process. Tool guidance depends on the fundamental accuracy of the machine, not the work as in drilling. It may be well to instruct men not to sacrifice this accuracy by calling for reaming since in some machines boring implies concentricity of holes with outer diameters turned, and normality with surfaces faced at the same setting.

For soft bearing metals, which should not be ground lest they be charged with abrasive, and for plastics, cast iron or in some cases soft steel, the diamond boring machine is a return to basic principles in machine work which deserves recognition by engineers. Use of tungsten carbide tools in this type of machine is in order for plastic and fabricoid materials and wherever the unaccustomed setting, forming and first cost of diamonds introduce difficulties.

Should Consider Bar Stiffness

Aligned holes in opposite sides of housings are best bored with a bar. Such holes never should be placed and dimensioned without careful consideration of the stiffness of this bar. A long slender arbor may not only fail to bore with the required accuracy but the boring time may be out of all reason when compared with the amount of metal removed. In such design the antifriction bearing is an indirect benefactor introducing large diameter seats of short axial length.

The boring of three or more holes in line usually cannot be accomplished without special intermediate boring bar guides to eliminate chatter, and in heavy work bar deflection due to gravity. It should be undertaken only when absolutely necessary. Line reaming of such

jobs by use of shell reamers on long slender shanks is a process of questionable accuracy to be ordered with judgment.

Rather than merely designating tolerances of different classes by letters, they may be put forth instructively as "Class A for Diamond Boring and Grinding," "Class B for Lathe and Mill Boring," etc. The grinder will remove a small fraction of a thousandth of an inch. The metal tool must be kept in the cut so that the chip strikes back of the lip or be worn away. For this reason diametral limits in grinding may be as narrow as required while it is ridiculous to reduce boring tolerances to tenths of thousandths unless diamond boring is contemplated.

Naturally all shouldered work must be chambered to allow grinding wheels to run out, a well known point too often neglected. The shop often will relieve slightly with a square nose boring tool where the relief does not appear on the drawing. It should be specified invariably to insure fillets at corners.

Advocates Needed for Lapping

Lapping is confused too often with polishing and needs responsible advocates. The term "polishing" as used in the metal working trades implies a brilliant finish with little regard for accuracy, the abrasive being carried on yielding and resilient surfaces. The luster required can be attained only when the scratches made by the abrasive are parallel.

In true cylindrical lapping the direction of abrasive action is a resultant of reciprocating

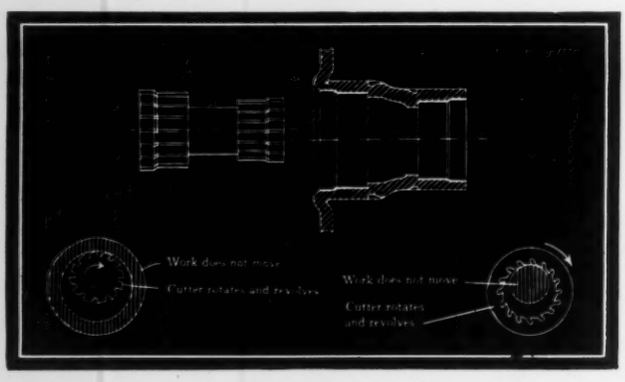


Fig. 5—In planetary miller the cutter spindle is carried in a pair of adjustable eccentric sleeves

and rotary motion of tool and work. This gives a mat finish in which the "marks" or scratches are crossed. The lap itself is of such construction that it possesses little diametral spring, and the metals used for the cutting part, either lead, copper, soft brass, bessemer steel and soft gray iron, are of a plastic nature. The lap usually is softer than the work in order to produce a matrix for the abrasive as it is crowded between the two. In fact the matrix soon takes on the appearance of a regular cylinder of fine grit.

Honing is a production process akin to lapping. Its advance is due to the desire for the results of the lapping process without its often prohibitive cost. Just how closely it follows the fundamental principle depends on the construction and use of the honing heads.

Originally the hone comprised a head carrying three or more hinged wings covered with

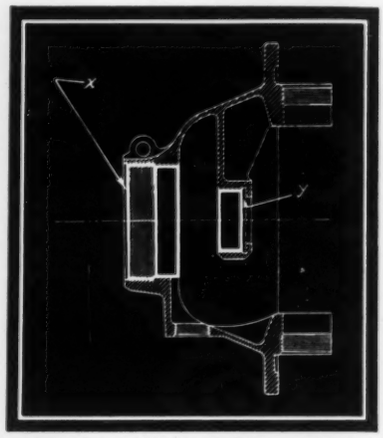


Fig. 6—Inner sleeve of machine head shown in Fig. 5 revolves about sixty degrees to advance the mill to its full depth in the cut then picks up the outer sleeve and rotates concentrically

emery cloth. The wings were free to assume any radius permitted by the work under the influence of springs or centrifugal force. This, it will be understood, is simply a polishing apparatus and nothing more. Briquets of suitable abrasive or oil stones have replaced the yielding polishing pad. The wings are positioned by locking devices and retracted, not expanded, by springs, Fig. 3. Spiders and hone carriers are as resilient as would be expected of such a metal structure—just elastic enough to enter the bore with a bite at the high spots.

Record Abrasives on Drawing

The abrasives used for grinding, lapping and honing should be recorded on drawings after due trial in the shop. Determination of suitable abrasive materials is an experience too valuable to be lost between jobs.

For those many classes of work where close fitting is not required and would perhaps tend to cause seizures, the broach is well adapted for finishing. It always has been held advisable to range finish marks across the line of motion rather than with it. This is a natural result of broaching. No automatic and few turret lathes are equipped to chase threads, consequently tapped threads are much in use. The tap held in the turret with ordinary care cannot be expected to produce threads concentric with other operations.

Chasing as a second operation on an engine lathe cannot be popular as a production method

since the form of tool and the operator's skill play so large a part in the result. Automatic thread millers of the internal type overcome these difficulties with a production so high that they are used even for grease cups of the better sort. The work is marvelous for finish as well as accuracy. The thread miller in the simplest sense is nothing more than a screw cutting lathe with a drive for a cutter arbor on the carriage.

The most extreme variant in the evolution of this machine is the Planathreader. This machine also is used to generate circles by milling and consequently approaches the classification of a universal tool. In operation the work is stationary, permitting machining on jobs of any swing.

For bore milling there is no traversing of spindle, eccentric quill or work holder. For threading the spindle is advanced one pitch per revolution of the head. Circular or hole milling and threading may be conducted simultaneously if there are no shoulders to interfere with the axial movement of the thread mill as in Fig. 6*x*, or if clearance is provided at the shoulder as in Fig. 6*y*.

Permits Single Setup

This solves the problem of producing threads about the same axis as co-operating bores, formerly impossible with a single setup except on the engine lathe. Internal and external threads may be cut simultaneously provided they are of the same pitch and hand.

As set up for milling the machine solves the old problem of opposed bores and shoulders, Fig. 5 so often required in mounting antifriction bearings. Naturally the span between shoulders is limited by the required formed or gang mill rigidity. If the length is excessive relative to possible cutter or arbor diameter two-head machines are used approaching the job from both sides.

Ball seat bores also are possible as a forming operation in this machine without the excessive chatter produced by broad forming tools in the lathe and avoiding the delicate swing tool used when forming tools are considered advisable. Rigid pneumatic chucking is provided, consequently parts must be designed for firm seating and the avoidance of distortion by clamping.

The designer's attitude toward all threaded work should be to avoid any necessity for alignment with other operations. European designs are at fault most often in this respect and usually have to be worked over before they are adapted to our production. For instance Fig. 7*A*, shows a German compressor valve in which threading of a job often too large to swing in an engine lathe, is required to line. The American version *B* shows the valve guided by parts made by single setting operations so simple that alignment of the three parts is certain. The threaded plug is used only to compress the assembly.

There is an all too prevalent idea in both shop and engineering department that tolerances are a concession to weakness. Their justification is distinctly economic. They save time which is the major ingredient of marketable goods. They reduce stress on men and strife between the artisan and his ordained critics.

The desirability of tolerances established, it remains to systematize them. Tables never can replace judgment in the engineering department, some member of which must qualify to referee special cases and to determine the classification governing tolerances on a job or a machine.

Tables however, are necessary lest individuality run amuck. There are two bases for such systems: The standard hole basis; and the standard plug basis.

In the old days when a shop was fortunate to possess a single set of plug gages and only "standard" reamers were available the standard hole was the only conceivable basis of order. The idea was to finish all holes to a nominal size

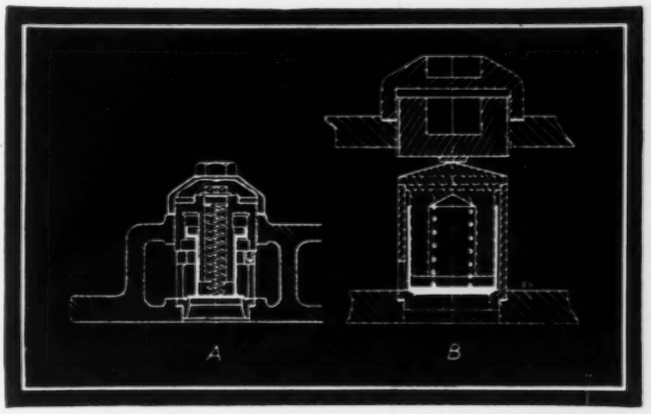


Fig. 7—Designers should avoid necessity of alignment of threaded work with other operations

with a tolerance to allow for reamer wear. The male piece then was made larger or smaller than standard also to limits. This remains a good basis and the Newall tables, long in use, are an excellent working example of the system.

The standard plug basis would require a number of small tools of each nominal size. This objection loses force when much work is ground, and it becomes a virtue when the General Motor's system of regrinding solid reamers to the next smaller classification is practiced. It also has virtues when much work is assembled on cold rolled, cold drawn, turned and ground or polished shafting.

These tolerance issues remain unsettled. Adequate discussion by users rather than makers of tools should precipitate a decision and thus define the issue. Makers of shafts and couplings may collaborate by interchange of gages but implicit agreement by mutual acceptance of standards is preferable.

MACHINE DESIGN

Editorial

Will Design Be Influenced by New Architectural Trends?

WITHIN a few short months the "Century of Progress" exposition in Chicago will be in full swing. Judging from present indications the architecture of its buildings and the character of many of its exhibits will reflect a marked tendency toward the "modernistic" in design.

Many of the exposition buildings embody the idea of simple lines, large unbroken masses of plain exterior surface and use of cubic, cylindrical and other geometric forms. This modernistic motif probably will serve as a challenge to the American People to determine how much of this new architectural idea they are willing to accept. Whatever the final appraisal may be, it will be important not only to architects, builders and manufacturers, but also to the designers of machinery.

Machine design and architecture have much in common. Architectural ideas are reflected in the design of many manufactured household machines, in automobiles, etc. To a lesser extent their influence is found in industrial machinery and equipment, as witness the straight-line forms of some welded products as compared to the traditional curves of cast and forged parts.

Engineers will do well to watch the reaction of the public toward the radically modern designs at Chicago. It will furnish a clue to the probable trend in certain phases of design over the next decade.

Broadening the Viewpoint

STUDY of economics by engineers cannot be over-emphasized under the stress of present day conditions. Never has there been a time when social, banking and administrative problems have played so important, and in some cases so devastating, a part in public welfare.

As tersely stated by A. W. Robertson recently, "We know little about economics or business. We spend all our time in improving, perfecting and marketing marvelous devices and machines—but little or no time in the study of basic factors governing our economic, social and political life."

Indications that ideas are changing are abundant. Colleges for instance, looking to the future, are giving much more consideration to the study of economics. Engineers obviously cannot specialize in this subject, yet a general knowledge of it undoubtedly would fit them more adequately to direct their activities not only in bad but prosperous times, besides qualifying them more thoroughly for the filling of high executive positions.

Richard Arkwright

Master Designers

Richard Arkwright

DEMAND is usually followed by invention, and when the invention has been perfected it ordinarily finds quick acceptance in the industry for which it was developed. Yet in England in the latter half of the seventeenth century even the great need for strong cotton thread did not allay the antipathy of manufacturers to the primitive spinning jenny designed by James Hargreaves and the practical model brought out by Sir Richard Arkwright, the builder of the first cotton power machinery.

ARKWRIGHT, an impecunious barber who visualized the need for better textile machinery, revolutionized the whole spinning world. He performed a critical revision of Hargreave's design and brought it into general use. Realizing the danger from hostile workmen who had destroyed earlier machines, Arkwright carried on his construction in greatest secrecy, informing inquisitive neighbors that he was searching for the secret of perpetual motion.

EVEN when the design was proved to be practical, popular feeling frightened bankers who withdrew needed backing. Arkwright was fortunate in securing assistance from some manufacturers of cotton products, but he still could not persuade many manufacturers to adopt his machine, even though they vitally needed the yarn that could be produced. To overcome this situation, Arkwright organized and built his own mill, demonstrating remarkable ability and founding a system of organization that has made modern factory manufacture and business administration a success.

THE product of this mill soon convinced the entire textile industry that the spinning jenny was requisite to future success, and manufacturers, instead of acknowledging their debt to Hargreaves and Arkwright, set to undermining the existing patents and succeeded by political manipulation in having them annulled. Long litigation ended in Arkwright's favor, but he did not require income from this source, his factory being an outstanding success even though it was without patent protection. Energy, industry and perseverance were rewarded and the man who had started his career as a poor, insufficiently educated tradesman died at 60 one of the richest men of his time.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Welcomes Letters or Solutions to Problems Suitable for Publication

Estimating by Sub-Assemblies

To the Editor:

ESTIMATING can be done methodically or haphazardly, but the methodical method is best and I would like to offer for the consideration of designers one of the better methods of estimating. Most machines may be divided into certain well defined sub-assemblies. The estimated labor and material to make up these sub-assemblies is compiled carefully. Then a summary is made of such sub-assemblies to obtain a total estimate of the entire machine, mechanism or structure.

This method assures that all items are considered correctly and included. It permits a more rapid checking of those items, thereby saving considerable time. It renders comparatively easy a change or substitution of some element for another in order to compare relative costs of a number of alternate designs.

In the estimating of cranes and hoists I have found this method exceptionally useful because it enables me to compile an estimate for a special crane or hoist easily and quickly. By choosing certain estimates, already indexed, of certain sub-assemblies, it is then only necessary to make up a new detailed estimate of the special parts required.

—CARL E. SCHIRMER,
Springfield, O.

Create Bushing Standards!

To the Editor:

RECENT discussions relative to the general standardization of bushings prompt me to suggest another aspect of the problem. While agreeing with those who consider such standardization desirable, I cannot help feeling that this is a case of trying to jump before we have walked. Fundamentally, standardization means the selection of a relatively few sizes of bushings which will serve the purposes of all engineering industries and all classes of work.

Lengths in which bushings should be stocked would not cause much discussion although to cover the field properly quite a number would be needed. The same applies to the nominal diameters which would be set up as standard. Much more of a problem is that of tolerances and fit allowances which would be classed as standard for the bores.

Bushing standards would have to provide for several classes of fits for each nominal size, both over and under nominal size so as to take care of both the basic hole and basic shaft systems of fits and tolerances. This is so much involved in the question of the establishment of a nationally accepted system of fits and tolerances that it would be premature to attempt standardization of bushings beyond a limited amount until the difficulties of standardizing fits are surmounted. Press fit allowances on the outside of the bushings are involved in the same difficulties. The American Standards asscciation set up standards for tolerances and fits of cylindrical holes on the basic hole system in 1925, but these have not been generally accepted as yet and it is understood that they are at present under review with the purpose of making the standards more acceptable to industry. This review should be completed and the revisions adopted before an attempt is made to standardize bushings.

—W. S. BROWN,
Auburn, N. Y.

AMERICAN tentative standards for annular ball bearings, single row type was approved as revised by American Standards association and designated as American Standard, B3.1-1933. The revision consists of a change from 0.4 and 1.0 millimeter to 0.6 and 1.5 millimeter, respectively, in the dimensions r and H of the light type bearing No. 39 (r designates the maximum radius of the fillet of a shaft or housing, and H the minimum height of the shoulder on a shaft). The revision also includes the addition of the separable (open) type ball bearings, and of the angular contact type ball bearings in the light, medium and heavy series.

The American Society of Mechanical Engineers and the Society of Automotive Engineers are sponsors for the project under the procedure of the American Standards association.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

FROM the ranks of manufacturers comes Howard Coonley to assume the presidency of the American Standards association. Well grounded in business and industrial fundamentals and a capable executive, he possesses a thorough understanding of the organization, assisted by experience as a member of the board of directors since 1928 when he was appointed to represent the American Society of Mechanical Engineers.

Chicago is the city of his nativity; November 22, 1876, the date. In 1899 he was graduated from Harvard college. Manufacturing pursuits in Chicago held him there until 1913 when he became president of the Walworth Co., New York, the post he holds at the present time. His business debut was made in 1900 with Walter Baker & Co. In 1902 he became vice president of the Coonley Mfg. Co., assuming the presidency in 1908.

Mr. Coonley holds directorships in several organizations, including Link-Belt Co., Chicago, and National Malleable & Steel Casting Co., Cleveland. During the World war he was vice president of the United States Shipping Board Emergency Fleet Corp., and 1925 saw him appointed chief of the first chemical warfare procurement district. In his new capacity he will be in a position to use increased influence on design work through further promulgation of engineering standards.

ON THE apprentice of today rest responsibilities of tomorrow. Industry therefore has not looked lightly upon the task of preparing these thousands of young men who in the future may design our machines and direct our technological progress. It numbers among its leaders in this type of work, Clement J. Freund. He made an international reputation at the Falk Corp., Milwaukee, as manager of personnel, apprenticeship and education. The latter part of last year he accepted an appointment as dean of engineering, University of Detroit.

Mr. Freund's career has been characterized by a varied experience from which he has obtained a keen perception of traits and qualities so essential in the training of younger engineers. A native of Appleton, Wis., he was born Aug. 7, 1895, and was graduated with a B. A. degree at Champion College in 1916. Subsequently he entered the college of engineering at Marquette university. The World War interrupted his studies; later he completed his engineering course at Marquette and graduated with a degree in mechanical engineering.

During 1921 Mr. Freund was a co-operative student at the Falk Co., the following year a student engineer, and became labor foreman in the foundry department in 1923. A year after, he was assigned to the apprenticeship department and in 1926 was placed in charge of apprenticeship and personnel. His activities in association work have been many and varied and he has contributed extensively to the technical press.

INTIMATE association with the refrigeration industry since the pioneer days of 1896 is the record of Louis S. Morse. As an executive engineer of York Ice Machinery Corp., York, Pa., he fills a responsible designing position. Recently the American Society of Refrigerating Engineers named him a director for three years of the society, an appointment he has held on two previous occasions. Throughout his career Mr. Morse has been engaged actively in various phases of design and construction of refrigeration machinery.

Born in Sommersworth, N. H., in 1873, Mr. Morse was graduated from Massachusetts Institute of Technology in 1896 and thereupon entered the employ of the York Mfg. Co. Upon the death of Gustav R. Brostrom, chief engineer, he was advanced to fill the duties of that office.

Mr. Morse is a member of the American Society of Mechanical Engineers also. He has been particularly active on committees of the Society of Refrigerating Engineers and has contributed several papers before the society. In the refrigerating Machinery association he is a member of the standardization committee.

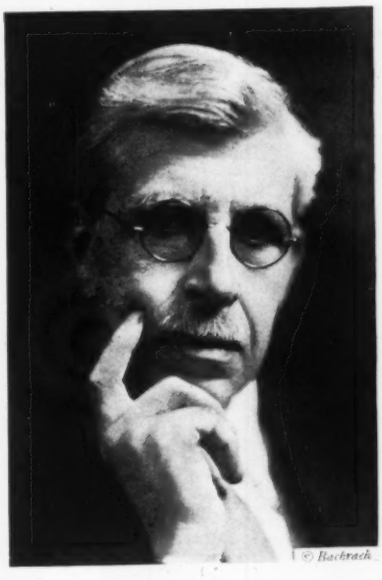
HAVING devoted almost his entire engineering and business career to the automobile industry, F. E. Moskovics knows the importance of standardization. With this background, colored by outstanding attainments in design, he takes over the duties of vice president of the American Standards association.

Mr. Moskovics first entered the automobile

Leaders in Design, Engineering and Research

HOWARD COONLEY

CLEMENT J. FREUND



LOUIS S. MORSE

F. E. MOSKOVICS

field in Europe with Daimler, following studies at the Armour Institute of Technology in Chicago, and also abroad. Later in this country he was a partner in the firm of Brandenburg Bros., designing, manufacturing and selling automobile parts. In 1907 he became general manager of the Kingston Motor Car Co. and in that year he designed his first automobile, the Allen-Kingston.

Subsequently Mr. Moskovics was connected with Remy Electric Co., Anderson, Ind., as sales manager, and with the Nordyke and Marmon Co., Indianapolis, as vice president. In 1924 he assumed the vice presidency of Franklin Automobile Co. and in 1925 became president of the Stutz Motor Car Co., resigning after four years. Besides being chairman of the board of Marmon-Herrington Co., Mr. Moskovics is vice president of the Frederick H. Levy Co., New York.

* * *

Nelson B. Garden has returned to H. W. Swoboda Inc., Pittsburgh, consulting electrical and mechanical engineers, in connection with heating and engineering problems.

* * *

Edward N. Hurley Jr. has been re-elected president of the American Washing Machine Manufacturers' association. This is his fourth consecutive term.

* * *

Richard Goetz, inventor of the "needle bearing" has returned to Berlin, Germany, after a business visit in this country. During his stay in America he made his headquarters with Emil Gruenfeldt, Guarantee Title building, Cleveland.

* * *

Harold V. Coes, manager of the industrial department of Ford, Bacon & Davis, New York, has been elected president for 1933 of United Engineering Trustees Inc., joint agency of the four founder engineering societies.

* * *

Raymond L. Collier, for a number of years assistant managing director of the Steel Founders' Society of America, has been appointed managing director of that organization to succeed Granville P. Rogers, who has severed his connection with the society to become affiliated with the Paper Cup Manufacturers institute, New York.

* * *

James H. Gleason, Cleveland, has completed a period of 24½ years' service with the Gas Machinery Co. as draftsman, erecting engineer, chief draftsman, and for the past five years as chief engineer, having supervision over the design, engineering, manufacture, and erection of the equipment. He will engage in a general engineering consulting practice.

* * *

Harold D. Church has resigned as vice president in charge of engineering of the White Motor Co. and now is vice president in charge of engineering and manufacturing at Winton Engine Corp., Cleveland.

* * *

William B. Mayo of Detroit recently was re-elected chairman of the Michigan State Board of Aeronautics.

* * *

F. J. King, chief engineer of the Linde Air Products Co., was elected president of the Compressed Gas Manufacturers' association at the annual meeting held at the Waldorf-Astoria, New York, recently.

* * *

Thomas A. Morgan, president of the Curtiss-Wright Corp. and North American Aviation, Inc., has been chosen president of the Aeronautical Chamber of Commerce of America, succeeding Charles L. Lawrence.

* * *

W. J. Dana, formerly with North Carolina State College, has become professor of mechanical engineering at Duke university, Durham, N. C. At the recent sixteenth annual meeting of the North Carolina Society of Engineers he was elected president.

* * *

Earle S. Henningsen has been appointed engineer in charge of the newly formed motor and generator engineering department of General Electric Co., Schenectady, N. Y. I. A. Terry is assistant engineer; and A. P. Wood, consulting mechanical engineer.

Obituaries

AUGUSTINE DAVIS, 80, pioneer in the development of oxy-acetylene welding, inventor and journalist, died at his home at Kew Gardens, Long Island recently. Mr. Davis for several years engaged in journalistic work and then became particularly interested in mechanics. In 1896 he invented an acetylene lighting generator, establishing the Davis Acetylene Co. with a plant at Elkhart, Ind. In 1906 he established the Davis-Bournonville Co., Jersey City, N. J., also invented an acetylene pressure generator which, in principle, is in use today.

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

PROVISION of a dynamic vibration absorber offsets the vibratory movement of actuating parts of a hair clipper for which a patent recently has been granted. This design, conceived by Irving O. Miner for Brown & Sharpe Mfg. Co., damps out the vibrations set up in the casing.

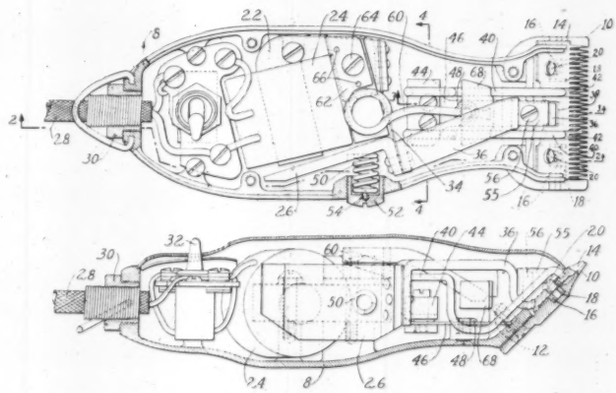


Fig. 1—An absorber unit consisting of a weighted spring offsets vibratory motion of clipper parts

Power for operating the clipper, shown in Fig. 1, is supplied by an electromagnet to which driving impulses are imparted at a rapid frequency by alternating current to secure vibratory movement of armature 26 arranged to oscillate blade 14.

To eliminate vibration, an absorber unit has spring 60 formed integrally with plate 62. This plate is secured rigidly by screw 64 and pins 66 to the clipper casing. At its free end the spring carries a weight 68 which is adjusted relatively to the strength of the spring to impart to the vibration absorber a natural period of vibration which will be equal to the period of vibration set up in the casing by the moving parts of the clipper.

Vibration of the casing will tend to set up a corresponding vibration of the absorber unit which will be 180 degrees out of phase with the vibrations of the casing and of a corresponding intensity of amplitude to damp out the vibrations. Damping out at all times the counter vibrations set up in the clipper casing by the vibratory movement of the armature and movable blade will have the effect of preventing any change in the tuning of the system and consequent faulty operation of the clipper due to the tendency of other objects brought into contact with the casing during the operation to produce a damping effect on these vibrations.

To provide an adjustment of the armature to regulate the air gap between the armature and the electromagnet and also to provide means for holding the armature in contact with a side of slot 38, compression spring 50 is seated in a hollow nut 52, screw threaded into one side of the casing. This spring bears against the armature at a point adjacent to its pivotal connection with spring 34, tending to move the armature toward the poles of the electromagnet against the action of springs 40. Disarrangement of the coils of spring 50 is prevented as nut 52 is turned up or backed off to vary the load on the armature. This is effected by the base end of the spring being bent inwardly and down to provide a centrally located pivot 54. To assist in the tuning of the vibrating system which includes the springs mentioned in the foregoing, the movable blade and the armature, with relation to the impressed impulses of the alternating current, a weight 55 is secured by means of screw 56 to the forward end of armature tongue 36. No. 1,895,292 identifies the patent.

WHILE designers must study carefully the causes and effects of vibration and be able to work with such recording devices as described on page 14, it also is imperative that they be able to combat vibration successfully. In the foregoing patent a method of damping is outlined for

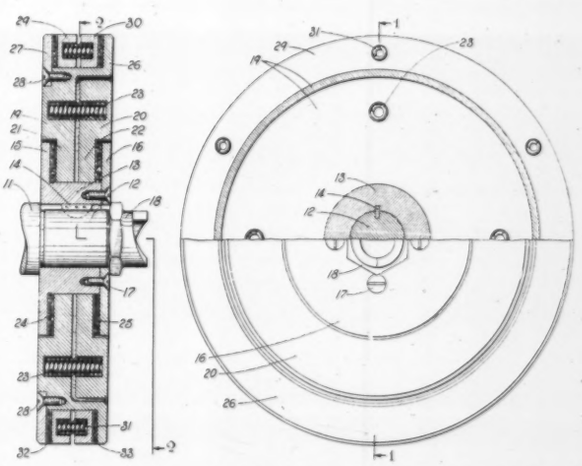


Fig. 2—Torsional vibrations are dampened by slippage of members at predetermined critical speeds

hair clipper design; the following invention provides dampening of torsional shaft vibrations as encountered in internal combustion engines. It will be understood that during the operation of such engines the crankshaft is subject to certain natural periodic vibrations, their characteristics varying according to the design of the shaft. At certain critical engine speeds, explosions or power impulses will occur in phase with the natural vibrations of the shaft, resulting in vibrations of high amplitude.

Shown in Fig. 2 is the device patented by Clyde R. Paton for the Studebaker Corp., South Bend, Ind. On crankshaft 11, members 19 and 20 form a primary vibration dampener. Springs 23 press the members into frictional engagement with flanges 15 and 16, thereby effecting their rotation with the crankshaft. These members 19 and 20 slip at a certain critical speed of the shaft to dampen out the torsional vibrations.

Members 29 and 30 form a secondary vibration dampener rotating with the crankshaft simultaneously with member 19, but adapted to slip at a critical speed different from that at which members 19 and 20 slip. Moment of inertia of members 19 and 20, the strength of springs 23, and the form and coefficient of friction of rings 24 and 25 are so calculated as to cause slippage at predetermined critical speed, and the resistance to inertia offered is so proportioned that the energy generated by the torsional vibrations of the shaft at that speed is absorbed and dissipated. The same is true for the parts comprising the secondary dampener. A third assembly may be mounted on ring 29, designed to slip at a third critical speed. The patent is designated No. 1,-896,969.

DRIVING action between clutch members is obtained through a series of balls, arranged in a spiral groove around the periphery of a truncated cone-shaped inner body *B*, Fig. 3. This clutch, classified as the free-wheeling type, was designed by Walter C. Pitter, of Epping, England, and was recently patented in this country.

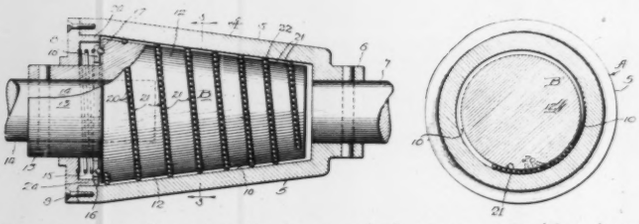


Fig. 3—A series of balls in a spiral groove provides free wheeling action between two clutch members

The patent, designated 1,895,678, states that rollers could be used instead of balls.

Between plate 8 and body 12 there is an expansion spring 15 pressing against a flat ring 16 providing with the end of body 12 a race for balls 17 forming a ball bearing. The groove 21 has a depth approximately one-half the diameter of steel balls 20 which occupy the groove or spiral slot in close arrangement. Because spring 15 causes balls 20 to be maintained in close association with conical surface 10 and since the series of balls has screw thread properties, the action is such that when either *A* or *B* is rotated in what would be an unthreading direction, the two members are not clutched together.

If the driving member, which may be either *A* or *B*, is rotated in a direction as to thread it upon the other member, a gripping action takes place and the two member are locked together. Should the driving power be interrupted the driven member will continue to move in the direction in which it is driven. This type of clutch is particularly adaptable where there is back and forth, ratchet-like movement of the driver.

UNIVERSAL joints by virtue of their characteristics often impose limitations on the designer. The maximum degree of angularity at which shafts will operate successfully is one of the common problems encountered; however, Roland Chilton has patented for the Eclipse Machine Co., Elmira Heights, N. Y., a universal joint wherein there is no change in the velocity ratio and no mechanical interferences even though the angle between the shafts be taken up to or beyond 90 degrees. Fig. 4 shows the construction by which this is accomplished.

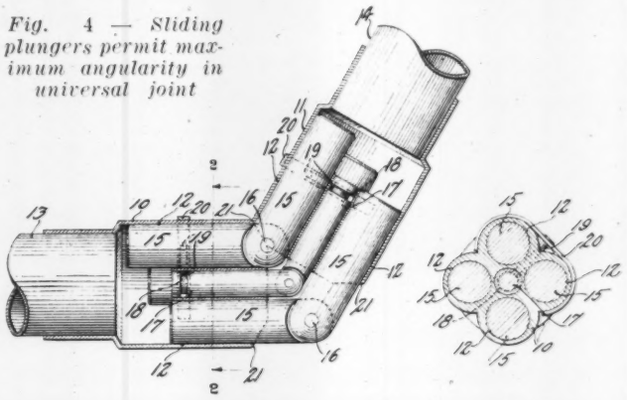
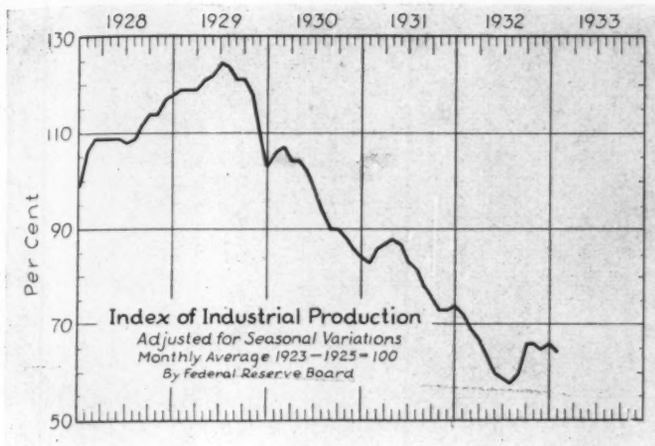
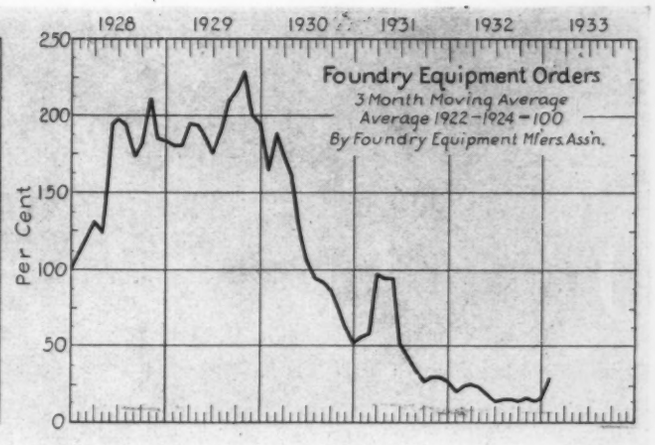


Fig. 4 — Sliding plungers permit maximum angularity in universal joint

Plunging members 15 are capable of sliding and at the same time rotating in bores 12. Clevis connections between the two sections of these plungers are secured by pins 16. The drive is transmitted by bending action of the plungers about which the shaft heads rotate, motion of the plungers being planetary.

Geometry of this joint is such that pins 16 of the intermediate members or driving plungers 15 always remain in one plane, that is the plane bisecting the angle between the shafts. A unit with the preferred form of clevis joint is not suitable for small angles between shafts, where conditions approach true alignment. This is because there is a tendency for the plungers to rotate with the shaft heads, thus turning the clevis joint sidewise to the direction of flexure which would destroy the connections. No. 1,896,133 has been assigned to the patent.



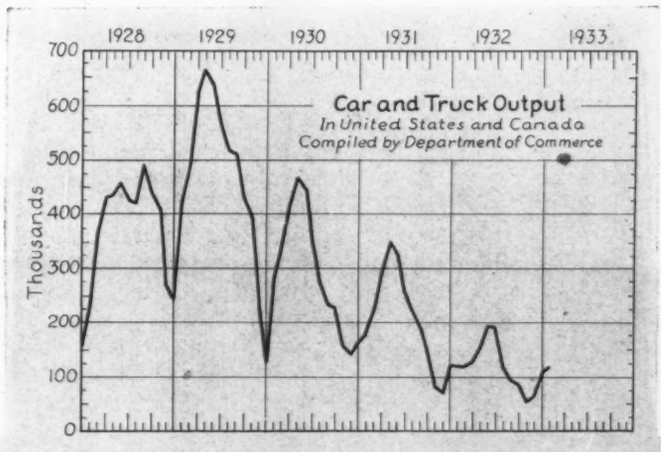


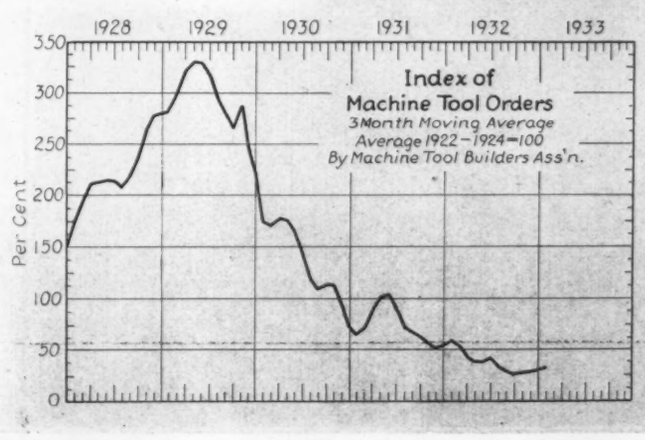
How Is Business?

INDECISION has been a more potent factor in delaying constructive business activity during the past year than is generally realized, one of the major contributions to this indecision being the lack of knowledge on what might be expected of the new administration. With the passing of March 4 much of this situation has been clarified.

President Roosevelt's appointments gave an early indication of the form of government that will prevail. Although few of the members in the new cabinet are widely known, the fact that they will reflect and carry out the wishes of the President removes much uncertainty as it reduces the probability of change to those constructive actions proposed by the chief executive. The known stand of secretaries Hull and Wooden on economic problems is especially encouraging.

Activity during the first few months of 1933 has maintained the gains made during the close of 1932. In fact, some lines have made substantial increases. Chief among the gains has been that registered by the automotive industry which in January produced for the first time since August, 1931 more automobiles than was produced in the corresponding month of the preceding year. The production this year was 5 per cent over that of January 1932. Foundry equipment demand also registered a sharp increase, the index of gross orders of 68.4 being the highest since April 1931. The three months' average of gross orders was 33.5 the highest since August, 1931.





TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

Believes Aluminum Will Take Lead in Future Design Work

PROPHECY of an aluminum age as the next metal cycle in civilization was made recently by Dr. Colin G. Fink, head of the electro-chemistry department at Columbia university. He pointed to aluminum as the most abundant common metal in the earth's crust, assuring that although the supply of raw material for many metals is comparatively limited in years, the quantity of bauxite or aluminum ore is almost limitless.

The keynote of the coming era as seen by Dr. Fink, is the large number of new devices and products. Aluminum, he believes, will be the outstanding metal to enter new fields. In his discussion he mentioned briefly the new aluminum plate which is claimed to be superior to tin plate in many respects, developed at the electro-chemical laboratories at Columbia. There is every indication, he says, that by 1942 the world's output of aluminum will total 600,000 tons, equivalent in volume to the world's production of copper in 1929.

Technical Societies Organize to Raise Engineer's Status

SEVEN national engineering bodies have organized the Engineers' Council for Professional Development with the object of advancing the professional status of the engineer. This new agency plans to co-ordinate and promote efforts directed toward higher professional standards. Its immediate objective is the formulation of a system whereby the progress of the young engineer in gaining a professional standing can be recognized by the man himself, by the profession and by the public through the development of those qualifications which render the engineer a valuable member of society.

Patent Reveals Air Conditioning Was Given Study in 1855

CASUAL observation of present intensive air conditioning development might lead to the belief that it is a comparatively recent innovation. The fact is, however, that some of the principles employed in our modern systems were embodied in a patent, No. 12851, granted to Job R. Barry, Philadelphia, nearly 78 years ago—May 15, 1855, to be exact. This interesting engineering information was resurrected by C. E. Carey and published in a recent issue of *Railway Mechanical Engineering*.

Seventy-seven years to commercialize an idea is a long time to wait, says Mr. Carey; we agree. Particularly significant is the fact that the car cooling and ventilating apparatus patented applied to railroads. As he points out, the commercial adaptation of air conditioning machinery for railway cars had to await the development of the electric generator, motor and mechanical refrigerating equipment. One fact stands out, however, the railroads even in 1855 were giving thought to the question of air conditioning.

Billions Saved by Research Activity During Past Twenty Years

RESEARCH during the past 20 years to improve the design and manufacture of incandescent lamps saved the American people more than two and a half billions of dollars during 1932. This statement, which comes from a large lamp producer, is proof of the value of research. Based on the estimated sale of 347,000,000 large lamps during the year, the public spent $86,500,000, whereas in 1912 they would have cost $326,000,000. Moreover, these modern lamps will produce 294 billion lumens of light as compared with 92 billions of lumens which would be furnished by lamps of 1912 design.

Standardization Has Not Felt Effects of the Current Depression

STANDARDIZATION, considered one of the most important elements in engineering progress, has been stimulated rather than retarded by the depression. Proof of this is emphasized by the activity in this direction at the recent annual meeting of the American Society of Mechanical Engineers. Meetings were held

by 23 standards committees with a total attendance of 283 men representing the numerous industries concerned.

The several standardization projects being developed by these 23 national committees and for which the A. S. M. E. is sole sponsor or joint sponsor may be classified broadly in the five following groups: Small tools and machine tool elements, pressure and vacuum gages; pipe and fittings; leather belting, classification and designation of surface qualities.

Industry was well represented and indicated a decided interest in the development of standard surface quality specifications and designations. In order to facilitate the activities of this committee, which cover a broad field affecting many industries, five subcommittees were appointed, to each of which a definite phase of the work has been assigned. It will be recalled that MACHINE DESIGN several times in the past has published articles and comments on surface qualities and urged engineers to give this factor more intensive study.

University of Pittsburgh Offers Course in Engineering Distribution

FOR the first time, insofar as is known, a graduate course in engineering devoted to a study of capital products, is being offered by a university. Under the direction of Bernard Lester, Westinghouse assistant sales manager, the University of Pittsburgh recently added this type of study to its curricula.

The innovation is not a business course on commodity marketing. It will take up problems in the sale and distribution of engineering equipment and machinery required by industry; a study of the industrial market; methods employed in economic distribution, direct and through sales features of engineering products; organization and supervision of sales force, sales methods, specifications, proposals, sales presentation and use of sales aids; problems involved in ordering, packing, transporting, installing, servicing, supplying repair parts and meeting foreign needs.

Exports of Specialized Machinery Are Higher Than Standard Types

MECHANICAL equipment, agricultural and industrial machinery and automotive equipment exported by the United States in 1932 showed a much larger proportionate decline in value as compared with the preceding year than did total exports. Automotive exports dropped 49 per cent, industrial machinery shipments declined 60 per cent and exports of agricultural implements were reduced 82 per cent in value in 1932 as compared with 1931, according to the department of commerce.

Exchange difficulties due to depreciated currencies, the rising of new tariff barriers and a further slump in industrial production during the year probably were the principal factors causing the drop. World wide decrease in production has been reflected in the lessened demand for standard industrial machinery. The market for specialized types of machinery has held up relatively better than that for the more standard types.

Acts to Prevent Misunderstanding of Technical Abbreviations

FREQUENT misunderstandings arise among scientists and engineers because of the use of different abbreviations for technical terms. These have led to the establishment, under auspices of the American Standards association, of a tentative national standard for abbreviations for the most common terms.

The standard has been published by the American Society of Mechanical Engineers, one of the five national engineering and scientific organizations which are taking the leadership through the agency of the American Standards association in the preparation of a long series of national standards for technical symbols as well as abbreviations for all branches of science and engineering. The other four organizations are the American Association for the Advancement of Science, the American Institute of Electrical Engineers, the American Society of Civil Engineers, and the Association for the Promotion of Engineering Education.

Volume Promotes Suggestion of Standard Machine Speeds

INDICATIVE of the mounting interest in standardization of machinery speeds is the publication of a new book in German by Dr. Ing. R. Germar with a preface by Dr. Ing. G. Schlesinger. In July 1931 MACHINE DESIGN discussed this subject briefly with reference to steps being taken by a committee working under the procedure of the American Standards association, with the American Society of Mechanical Engineers as sponsor.

The volume treats of a new simplified method of figuring gear drives, aided by calculation tables and chart, and extends the idea of speed standardization to the calculation of gear drives. In discussing the book, J. I. Hommel, Westinghouse standards engineer, asserts that it will enable the designer to select quickly the simplest way of changing existing tools to the new speed standards, and the most efficient drives, when entirely new work is being considered.

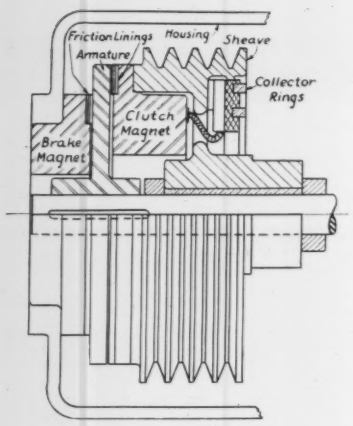
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Unit Combines Clutch and Brake

CLUTCH or brake action is provided by magnetic operation with the new combination device recently perfected by Magnetic Mfg. Co., Milwaukee. The magnetic clutch on the dual purpose unit, shown herewith, is 10 inches in diameter and has a torque rating of 1000 inch pounds. It is mounted inside the driven sheave which idles on the shaft.

The magnetic brake is 8 inches in diameter with a torque rating of 350 inch pounds, and is



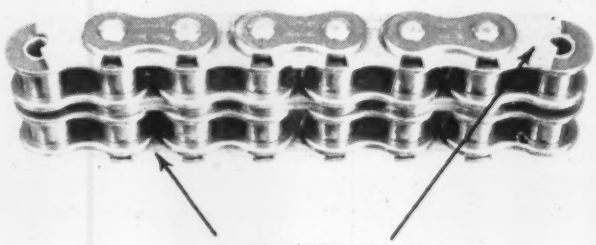
Magnetic device combines the functions of both clutch and brake in one compact unit

mounted in a fixed position in the housing of the spindle gear box. To conserve space the collector rings are mounted within the sheave. The armature is slidably keyed to the shaft and is used for both clutching and braking.

Wedges Dampen Chain Vibration

A UNIQUE and efficient device for the prevention of vibration and whip in roller and silent chain drives has been developed recently by Whitney Mfg. Co., Hartford, Conn. The device, on which patents are pending, consists of small wedge-like elements which are assembled into the standard chains at every pitch. These wedges shown in the accompanying illustration, contact end to end and form a continuous stiff backbone throughout the length of the chain. Chains on which the check links are assembled will run on standard sprockets and will interchange on practically every drive where the standard flexible chain, contacting the sprockets on one chain face only, has been used.

The elements float on the chain rivets and do



Wedges contact end to end to form a continuous stiff backbone throughout the length of chain

not interfere with the normal chain joint action. They serve as check links to prevent back bend and chain whip or thrash when the load on the chain is of a pulsating nature, as would occur when the drive is from a gasoline engine to a pump, compressor or other intermittent load equipment. The stiff back chain is of particular advantage on nonadjustable chain drives as the supporting action of the check links and the elimination of excessive and destructive joint movement due to vibration prolongs the life of the chain.

Alloy Resists Dairy Product Corrosion

DESIGNED especially for use in the dairy industry, the new nickel-base chromium alloy developed by International Nickel Co. Inc., New York, known as Inconel, is produced by adding to nickel sufficient chromium to provide corrosion resistance without having any harmful effects on the malleability or workability of the metal. Chromium content ranges from 12 to 14 per cent; the iron content is about 6 per

● *Lower right:* Air cooled cylinder containing 1% Nickel produced by Parker-Street Castings Company, Cleveland, Ohio, for the Davey Compressor Co., Inc.

● *Below:* Davey air cooled compressor. Manufactured by Davey Compressor Co., Inc., Kent, O.

• LONGER LIFE FOR DAVEY AIR COOLED CYLINDERS

...they're Nickel Cast Iron

AGAIN Nickel Cast Iron proves its superiority! This time it's in air cooled compressor cylinders. To obtain improved performance, eliminate excess weight and assure greater smoothness in compressor operation, Davey air cooled compressors use "the longest wearing cylinder material known today". • The Parker-Street Castings Co. is producing Davey cylinders from a mixture containing 1% Nickel. This superior Nickel Cast Iron shows exceptional strength, heat and wear resistance. It is uniformly gray and, consequently, tough throughout—in the light section cooling fins as well as in heavier sections and along cylinder bores. • Consult our specialists concerning your casting problems. Their assistance entails no obligation.

•

THE INTERNATIONAL NICKEL COMPANY, INC.

Miners, refiners and rollers of Nickel. Sole producers of Monel Metal.

67 Wall Street **New York, N. Y.**

INCO NICKEL

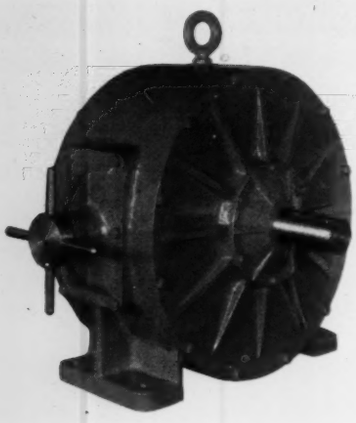
Nickel CAST IRON

A BETTER MATERIAL FOR MODERN NEEDS

cent. Advantages claimed for the material by its sponsors include: High resistance to corrosion from all dairy products, refrigerating brines, ammonia and cleaning or sterilizing compounds; nonrusting and noncontaminating; excellent welding and fabricating characteristics; and satisfactory heat transfer properties.

Can Vary Pump Discharge Volume

A COMPLETE new line of hydraulic pumps and motors of the rotary radial piston type has been announced by Northern Pump Co., Minneapolis. The pumps, shown herewith, are available in sizes from 1 gallon per minute to 2000 gallons per minute, and pressures of 4000 pounds per square inch, pumping oil for hydraulic systems. Volume of discharge can be changed to deliver any amount from zero to the maximum capacity of the pump, and the discharge can be reversed without stopping the pump or changing speed of rotation.



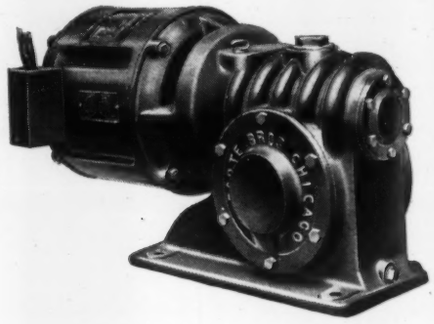
Discharge on new pumps can be reversed without stopping the pump or changing speed of rotation

All pumps are fitted throughout with nitralloy and incorporate a balanced pressure design to prevent heavy bearing loads at high pressures. A complete line of automatic controls and semi-automatic valve mechanisms is available for use with the pumps.

Announces Motorized Reducers

MOTORIZED reduction units in a complete line have been announced by Foote Bros. Gear & Machine Co., 5301 South Western boulevard, Chicago. The new lines cover a wide range of application in sizes and types ranging from ½ to 150 horsepower capacity and ratios ranging from 2:1 to 3600:1. The various types offered permit right angle, straight line or offset drives, either horizontal or vertical.

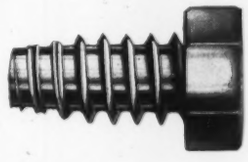
Motor characteristics may be varied to suit the particular application including normal starting torque, high starting torque, high slip, adjustable speed and multispeed. There are two main divisions of the line, the radiating worm gear type which has a case designed for radiation of heat which may be developed, and the helical gear types.



Radiating worm gear type motorized reducer has a case designed for radiation of heat that may be developed

Cap Screws Are Self-Tapping

SELF-tapping cap screws, hardened, with hexagon heads, have been added to the line of fastenings manufactured by Parker-Kalon Corp., 200 Varick street, New York. Like other types of these fastenings, the cap screws form their own thread in the material as they are run in. The screws are used with sheet metal from 24 gage to 10 gage; steel plate and structural shapes up to ½-inch thick; and solid sections of brass, bronze, aluminum and die castings, slate, transite board, ebony, asbestos, etc. They are made in a complete range of sizes from No. 6 to ½-inch diameter.



Hardened cap screws, self-tapping, are used with sheet metal from 24 to 10 gage and with other materials

Industrial Electronic Unit Developed

ESPECIALLY adapted to applications such as counting, limit switch, door opening, automatic weighing, and similar operations, the Photo-Troller brought out by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is a rugged industrial device which can be actuated by a phototube or by delicate contacts carrying only a few microamperes. The phototube or sensitive contact operates a grid glow tube directly which in turn closes a contactor capable

QUALITY

is but the start of a

LONG LIFE

. . . . FOR HYATTS

First to make sure that the necessary essentials are built into Hyatt Roller Bearings—then to make certain that the proper bearing is recommended for the job are the reasons Hyatts prove so satisfactory.

You get no more out of bearings than is put in, and there are so many factual evidences of extraordinary performances that Hyatt "controlled quality" becomes almost performance insurance. It is a worthy start to a worth-while end . . . efficiency, long life, economy.

Where there is a heavy load to carry, Hyatt bearings bear the brunt unflinchingly. Where it means long, exacting hours, Hyatts run along smoothly, steadily. For extreme conditions and for inaccessible positions there is more than enough leeway provided by sound engineering and manufacture to provide adequate safeguards against breakdowns and delays. Because so much care is exerted in the processes of production there is little need for care during operation. Attention is almost a negligible factor. Long, faultless bearing life is assured. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.

HYATT

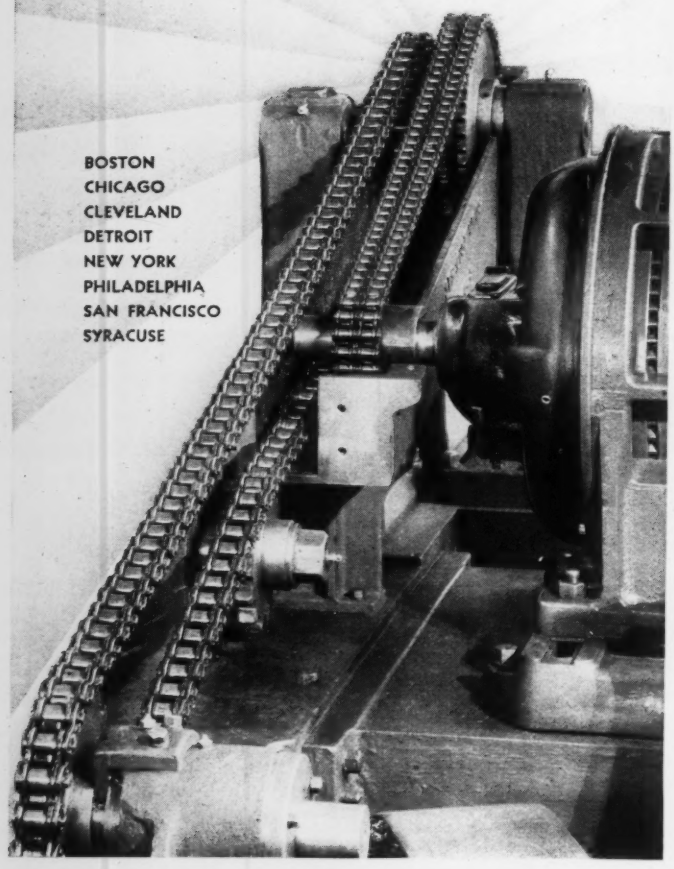
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

WHITNEY
ROLLER CHAIN
EQUIPPED

. . . means positive power transmission, plus-lasting efficiency and economy of operation.

THE WHITNEY MFG. CO.
HARTFORD, CONN.



BOSTON
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CLEVELAND
DETROIT
NEW YORK
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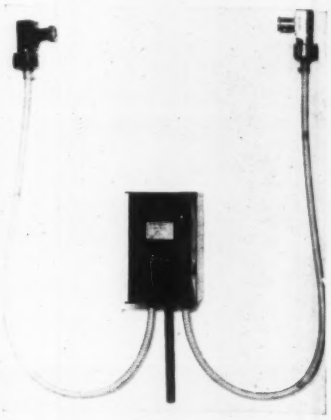
SAN FRANCISCO
SYRACUSE

of initiating any desired operation. Intermediate relays are eliminated.

Units, such as the one shown herewith, are assembled in a sheet metal cabinet and are available for any commercial voltage or frequency except direct current. The device contains a complete power supply for all auxiliaries including the light source. Various light sources may be obtained for operation at distances up to 22 feet from the phototube.



Phototube operates a grid glow tube directly which closes a contactor capable of initiating any desired operation

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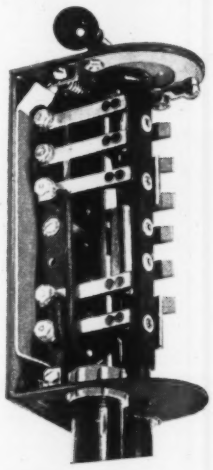
Drum Type Switches Are Compact

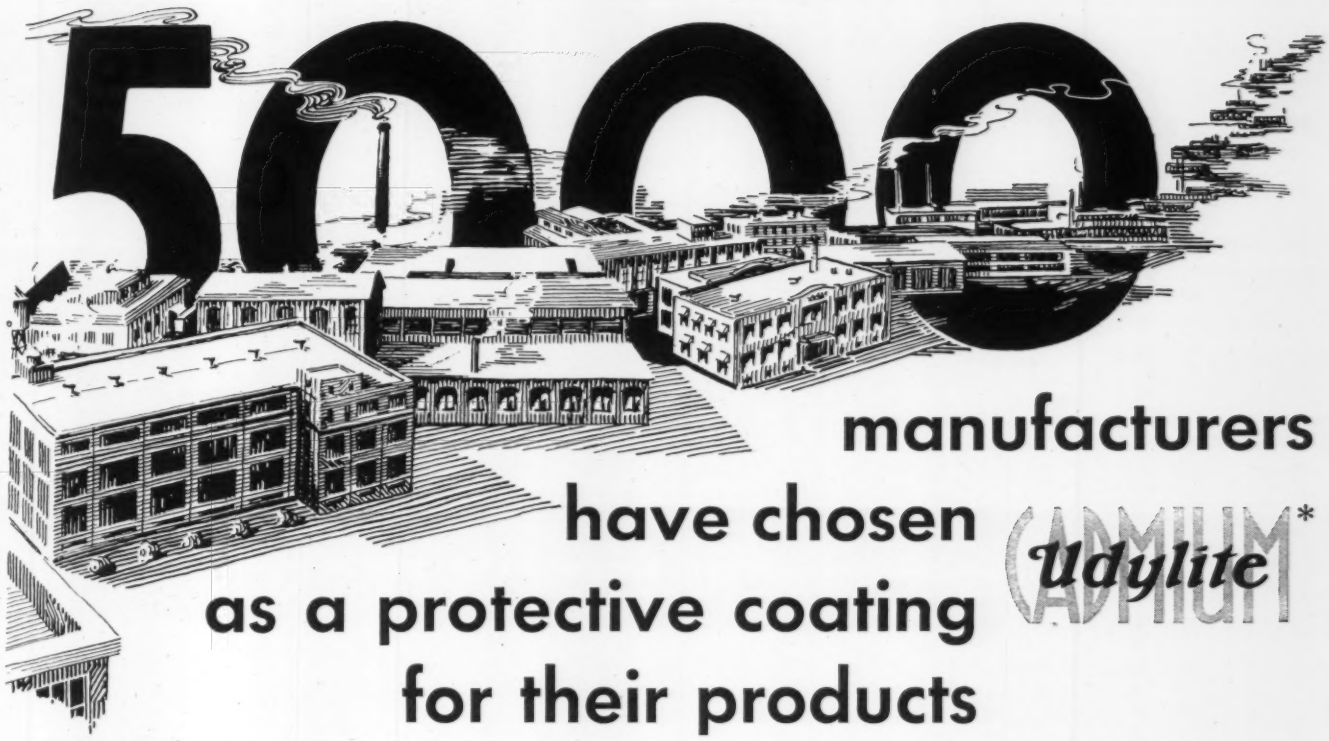
CONTROLLERS designed to provide compact drum type switches for the smaller sizes of motor have been made available by Furnas Electric Co., 1525 South Seventy-seventh street, West Allis, Wis. These units, built in sizes from ¼ to 3 horsepower, have frames of pressed steel and segments of hard copper. Steel pins, rollers and cams are case hardened, while Bakelite is used for insulation. Rotor spindles are of solid Bakelite with bearings top and bottom.

Reversing controllers are made in one frame



Multi-speed controllers are designed for two-speed motors either double winding or single winding consequent pole reconnected type

More than 5000 manufacturers have chosen Udylite* as a protective coating for their products



These manufacturers—more than five thousand of them—had definite reasons for choosing Udylite-Cadmium as a protective coating for their products. One corrosion problem was not common to all of them. Yet, each recognized Udylite-Cadmium as being ideally suited to his needs. . . . The very fact that so many manufacturers employ it as a rust preventive is ample evidence of its efficiency and economy. . . . Perhaps you have a corrosion problem—a thorn in your side which Udylite-Cadmium can easily eliminate. Just read over the properties of Udylite-Cadmium which are explained below. Then drop us a line. Our research staff will gladly work with you. There's no obligation of course.

* *Udylite . . .*

is a protective coating of pure, metallic cadmium applied to metal surfaces by an electroplating process—the Udylite Process. It adheres perfectly to the base metal and presents an unbroken, protective surface which moisture and other corrosive media cannot penetrate.

You can obtain Udylite-Cadmium from either of two sources, i. e., from the authorized Udylite job shop, one of which is located in every principal city or from the Udylite Process installed in your plant.

For the processing of small, irregular lots we recommend the services of the Udylite jobber. Where a plating production problem is involved we recommend installation of the Udylite Process in your plant. We carry a complete line of equipment and are well able to supply you with every plating requirement.

1. Udylite-Cadmium prevents the rust and corrosion of metals more efficiently than any other protective coating yet discovered. Its wide spread usage bears mute testimony to this fact.
2. Alkalies do not attack Udylite-Cadmium. Thus, it is the ideal coating for structural iron parts immersed in concrete, washing machine parts, lavatory partition hardware, and other products exposed to alkaline corrosive media.
3. The contact resistance of Udylite-Cadmium is remarkably low, which property has popularized its use on electrical control equipment. Three important reasons for its use in the electrical industry are low contact resistance, rust protection and appearance.
4. If your problem is salt air corrosion—Udylite-Cadmium is the answer. Thousands of tests have proven this coating to be impervious to the corrosive action of saline atmospheres.
5. Ductility is an important property of a protective coating because it may be easier for you to first plate and then fabricate. Many manufacturers do this with Udylite-Cadmium and effect substantial savings.
6. Udylite-Cadmium is applied in very thin coatings as low as two ten-thousandths of an inch. Hence, expensive undercutting of threaded parts is unnecessary.
7. The beauty of Udylite-Cadmium is undeniable. It imparts a silvery-white luster to the product and renders it more attactive and salable.
8. In choosing a proper finish, you are naturally concerned with cost. Udylite-Cadmium is a most economical rust preventive. Reason for yourself. Thin, efficient coatings—less time to apply them—lower equipment investment. The natural result is low cost protection.

UDYLITE PROCESS COMPANY

3937 Bellevue Avenue Detroit, Michigan

New York City, 30 E. 42nd St. Chicago, 205 Wacker Drive San Francisco, 114 Sansome St.

CURIOSITY

THEY say that "curiosity killed a cat". We doubt it. Did you ever tear up a watch to find out what makes it tick? It's an idea. Become "curiosity" conscious. Examine a Leland motor.

After you have thoroughly satisfied yourself *by exhaustive tests* that this design is undeniably quiet and cool running—after you have become convinced that there can be no transmission of vibration to the base and no misalignment of the shaft due to thrust—start looking for the 'whys' and 'hows' of these operating characteristics.

Inspect the mounting. There you will find a spring cradle mounting—an explanation of quietness, of freedom from vibration and stability of shaft alignment so characteristic of this design.

Then look within. There, along with other features, you will discover:

A sturdy, capable and time tested short-circuiting device—
A most simple form of brush-lifter that definitely eliminates noise and brush wear—
Generous bearing areas coupled with a circulating self-filtering lubrication system to prevent bearing trouble—
A most effective utilization of the material required to make a motor.

Bulletin No. 28

A. C. Repulsion-Induction
D. C. and Polyphase
Interchangeable Frames
Capacitor motors
Specials where required
Ratings ⅛ to 3 h.p.

The LELAND ELECTRIC Co.
DAYTON · OHIO · U·S·A

CANADIAN ADDRESS
TORONTO

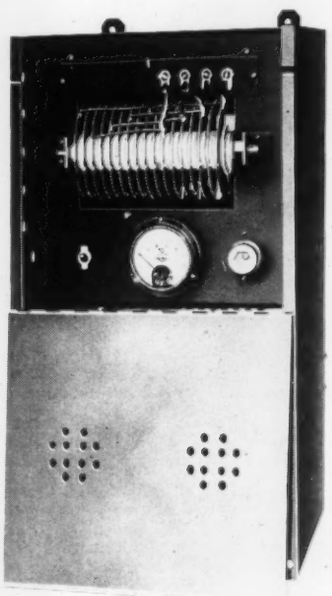
CABLE ADDRESS
LELECT

KONTAX MERCURY TUBES
Leland Motors
MERCURY TUBE CONTROLS

size with two different ratings. The smaller rating has a friction indexing device while cam and roller indexing is employed in the larger model. They have three positions: forward, off, reverse. Multispeed controllers are of similar construction. This series is not arranged for reversing and is for two-speed motors either double winding or single winding consequent pole reconnected type.

Rectifilters Power Any Equipment

NEW units using copper oxide and tube type rectifiers have been added to the line of rectifilters manufactured by the Recti-FilteR department, Square D Co., Detroit. The recti-

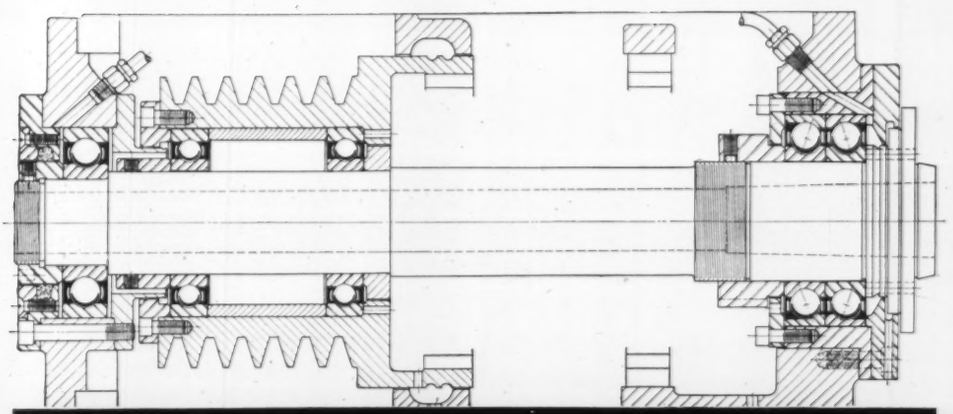


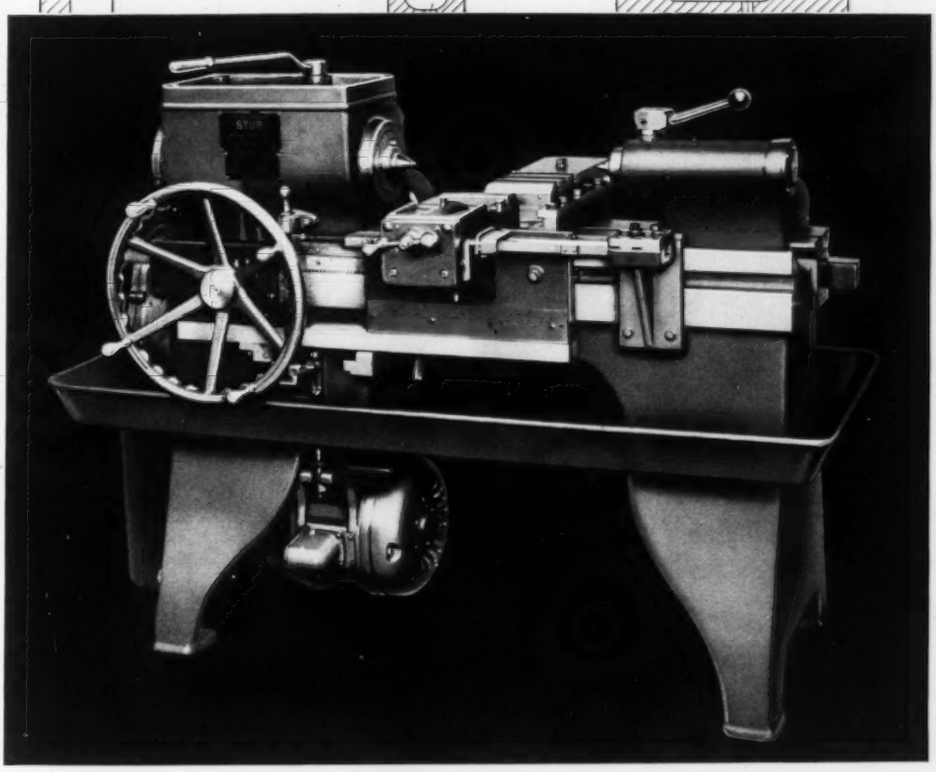
Copper oxide and tube type rectifiers are used with new line of rectifilters which convert alternating current from any source of supply into direct current

filter, shown herewith, converts alternating current to direct currect by connecting the input to any regular alternating current scurce of supply. Models are manufactured to power any equipment requiring direct current. Units delivering output with a degree of alternating component down to 0.0002 volts are available.

Aluminum Coating Is Ready Mixed

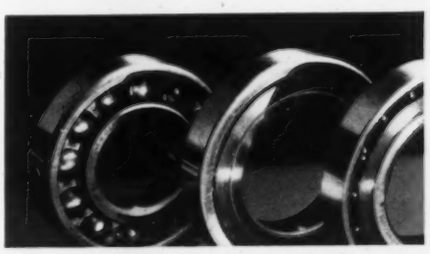
COMPLETE coating or coverage of a surface is attained with an unusually thin mixture by use of the new aluminum coating, called Permite Resalum, brought out by Aluminum Industries Inc., Cincinnati. The coating is ready mixed in a synthetic resin vehicle. By the use of Permite thinner the right consistency can be obtained for spraying, brushing or dipping. The special type of vehicle used allows thorough leafing of the fine aluminum powder. Two





See what SUNDSTRAND has done!

FROM Rockford, Illinois, comes news of a new lathe. Sundstrand calls it the Junior Stub. From the ground up it has been designed to take full advantage of modern cutting tools — both alloy and cemented. Particularly interesting is the manner in which the spindle is mounted on the models A and B. A pair of sturdy New Departure *Perfex* bearings are its forward support. Clamped back to back under *definite preload*, they guard the rigidity and control the accuracy of this important member. At the rear is a New Departure Single Row, so disposed that expansion or contraction of the spindle is compensated for without strain or deflection of machine elements. The drive pulley with inbuilt clutch is also mounted on New Departures, as are other vital parts of this machine. Well done, Sundstrand! . . . to this users will agree. There never was a better time for machine builders to revamp outmoded designs and incorporate New Departure advantages. Willing hands and heads are at your service here. « « « The New Departure Mfg. Company, Bristol, Conn.



NEW DEPARTURE
BALL BEARINGS

ALLEN

TRI-MARKT

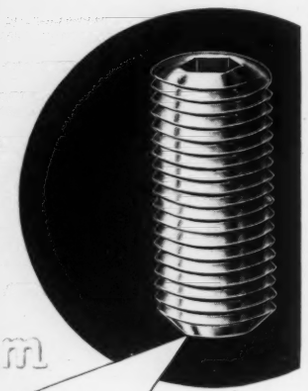
TRADE MARK

HOLLOW SCREWS

of

Chrome-

Mo-lyb-den-um



ALL

to the

GOOD:—no screws

you can't *USE* in a

package of "ALLENS"

Why not buy fewer screws—get more you can *use*—save money on WASTAGE as well as *breakage?* Allen's 6-step inspection system eliminates every imperfect screw before it gets to you. Each individual cap and set screw is *hand-inspected* before packaging. Rejects are scrapped at our expense, instead of passed and rejected at *your* expense. The saving on this one item alone may cancel out the paper-economy of longer discounts on screws that are short on inspection. *Watch your wastage*—or specify ALLENS so there won't be any to watch!

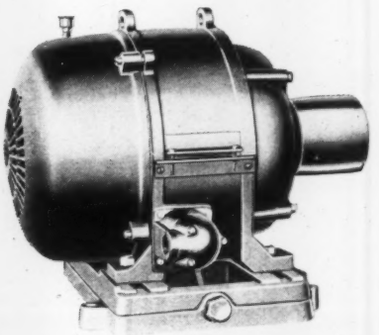
THE ALLEN MFG. COMPANY

HARTFORD, CONN. U. S. A.

grades are obtainable for use on all surfaces either inside or cutside. These grades are heat resisting and noncorrosive.

Fan Seal Motor Is Self-Cleaning

A NEW line of fan seal type motcrs in sizes ranging from 2 horsepower, 900 revolutions per minute to 30 horsepower, 1800 R. P. M., has been brought out by Marble-Card Electric Co., Gladstcne, Mich. The new motor, shown herewith, is self-cooling and self-cleaning. As it is entirely enclosed it is protected against dust, dampness and fumes. The fan sealed type eliminates the danger of fires and explosions.



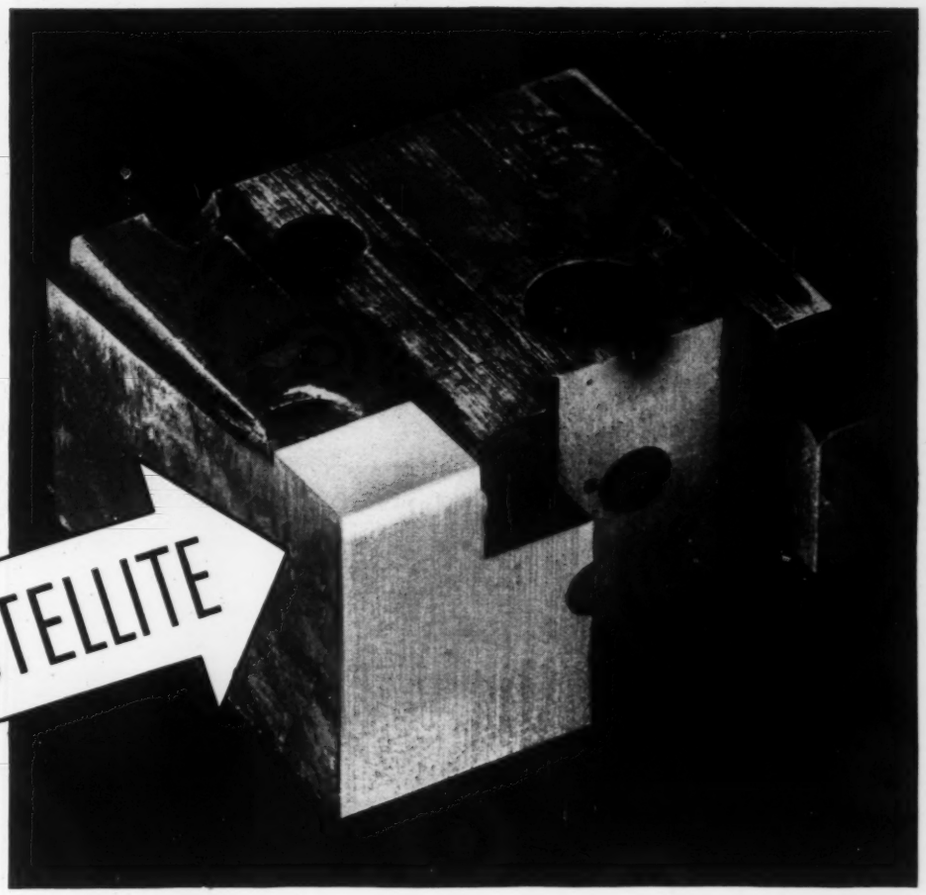
Entirely enclosed motor is protected against dust, dampness and fumes

Records Any Measurable Quantity

PHOTOELECTRIC recorders which will record any measurable quantity are a recent development of General Electric Co., Schenectady, N. Y. These instruments will give a graphic record of thickness of sheet metal, paper, etc. by use of an electric gage, and diameter of ball bearings, cylinders, wire, etc, by employment of the proper pickup.

In the operation, a highly sensitive galvanometer picks up the quantity being measured. A tiny mirror, mounted on the moving system of the galvanometer reflects a beam of light into two photoelectric tubes. The output of the tubes is amplified by a pliotron tube which supplies sufficient power to operate a high-torque recording element and this element gives a continuous record on the chart.

To accommodate men who are using this period of lessened activity to improve their knowledge of new developments, John Huntington Polytechnic institute, Cleveland, in co-operation with Lincoln Electric Co., will offer another intensive course in "Designing for Welded Construction," from April 3 to 10. Applicants should be college graduates in engineering or have equivalent practical experience.



● *Extreme accuracy throughout its entire service life is essential in this type-mold. Haynes Stelliting keeps it accurate five times longer.*

For Improved Products and Better Satisfied Customers

THE longer your product's service life, the better your customers will like it. The part Haynes Stellite can play in multiplying the life of metal exposed to heat and abrasion is excellently illustrated in the type blocks made by a prominent monotype company.

Three blocks like the one shown form the mold into which the molten type metal is poured. The raised corner regulates the height of the type. Made of steel, a block lasts only one year. But when the corner is Haynes Stellited, its life is increased approximately five times.

Haynes Stelliting these blocks is a standard production operation because it pays big dividends in customer-satisfaction.

Haynes Stellite's great hardness, which it retains even at red heat, is inherent, and is not the result of heat treatment. Easily and economically applied with the oxy-acetylene blowpipe, Haynes Stellite outwears plain steel three to ten times.

If Haynes Stellite's red hardness will improve your product, ask our Engineers to explain its application. Their assistance is a part of Haynes Stellite Engineering Service. Take advantage of it today.

HAYNES STELLITE TRADE MARK

A red-hard, wear-resisting alloy of Cobalt, Chromium and Tungsten

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

Chicago • Cleveland • Detroit • Houston • Los Angeles • New York • San Francisco • Tulsa

General Office and Works—Kokomo, Indiana

Foreign Sales Department—New York City

Haynes Stellite Welding Rods and information on other Haynes Stellite Products also are available through the 42 apparatus shipping points of The Linde Air Products Company

Is yours one of the 545
applications for Small Motors
Then be sure the motor you use will give the maximum service. The success of your product—its ability to repeat with users—depends upon the motor, the heart of the appliance.
Signal motors are made for your particular application. They are not stock type motors, and the reason they cost no more is that the entire motor is made in the Signal factory—not merely an integral part.
Your specifications will enable us to furnish you complete information on Signal small motors — designed to meet your specific requirements.
SIGNAL ELECTRIC MFG. COMPANY
Menominee, Michigan
SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS

Selecting Motors for Specialized Duty

(*Concluded from Page* 21)

the average loss and likewise the temperature rise in a motor operating on a reversing cycle is dependent to a large extent upon the frequency at which reversals occur. Fig. 5 shows several time-temperature curves of a 1 horsepower motor driving a multiple-spindle tapping machine and indicate the effect of rate of reversals as well as load upon the temperature rise during continuous operation. Curves 1, 2 and 4 are for 18, 32, 54 reversals per minute respectively with the motor developing its rated output in the forward direction and 50 per cent output in reverse, and show the effect of rate of reversal upon the temperature rise under constant load. Curve 3 shows the effect on the temperature rise due to increasing the load in the forward direction from 100 to 150 per cent rated output at 32 reversals per minute. Comparing curves 1 and 2, there is an 88 per cent increase in rate of reversal with a resulting 35 per cent increase in temperature rise while between curves 1 and 4, there has been a 300 per cent increase in rate of reversal with a 100 per cent increase in temperature rise. Increasing the load on the motor 50 per cent during the cycle of 32 reversals has the effect of increasing the temperature rise only 7 per cent in this particular case. This data indicates that a variation in the load within the limit of the rated capacity of the motor has a comparatively much smaller effect upon temperature rise than a change in the frequency of reversal.

Accurate Data Required

The chief problem of the motor designer in his work of designing squirrel cage motors for specialized service applications is that of obtaining complete and accurate data concerning the driven machine. A careful consideration of all the factors involved including WR^2, friction load, the time cycle, and operating speeds, through the co-operation of the machine designer serves to remove much of the guess work and a suitable motor design can be obtained by accurate calculation eliminating the necessity of a trial motor.

It is reasonably certain that the future will find the squirrel cage motor being adapted to more and more special purpose applications on individual machines, as it has already established itself as a means of refining the design of many new machines the performance of which depends upon properly applied motors.

Value of Rug Cleaner Increased by Diamond Roller Chain

SLIP, breakage or low efficiency could not be tolerated on Chief Rug Cleaning Machines.

Positive drives of the heavy rolls, dependable long time service, and simple accessible drives are all accomplished with Diamond Roller Chain — and as the manufacturer says, "these drives increase the value of the machines".

When designing any machinery—when making changes in models, it will pay you in extra value and in manufacturing cost, — to consider Diamond Roller Chain.

It costs you nothing to ask for a suggestion — our engineers with 40 years of accumulated experience are ready to be of assistance.

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Offices and Distributors in All Principal Cities

Short centers, long centers, slow speeds, high speeds,—Diamond Roller Chain adapts itself to a great multiplicity of applications. In Booklet 104-A many of these are described and illustrated. If you haven't a copy clip the coupon reminder and mail.

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This Diamond on every link identifies the Diamond Drive

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A-6617

Varied Use Governs Hammer Design

(*Concluded from page 29*)

quires a hammer of great endurance. The tacking of covering material by girls in automobile factories demands a light, easy-working tool.

The indispensable qualities which must be built into such a hammer were listed as follows and indicate in a general way the order of their importance: Ease of operation; endurance; quick loading; utmost capacity; freedom from jamming; and cost. Certain minor features deemed desirable were: A rigid closed handle; absence of screws and nuts; assembling and disassembling in the field without the aid of tools; and the use of pressed and stamped parts.

Results with experimental devices made up to determine the best driving principle pointed toward an inertia drive but the driving of a staple only $\frac{3}{8}$-inch long into hard dry maple called for a head of prohibitive weight, or required tiresome effort. At this point the happy thought of incorporating a striker member which accelerates the movement of the driver led to a satisfactory solution of the problem and so constituted the basic principle around which the hammer Fig. 1*A*, was built.

It will be noted that the driver lever, Fig. 2, in oscillating about its pivot imparts an up and down movement to the driver and the striker being of bell crank form is arranged to impart a snap to the driver lever when the striker makes contact with the work.

The door is held closed under predetermined spring tension but may be swung open easily to insert a strip of staples. A pawl is arranged to engage the strip of staples only when the door is open, thus preventing the staples from flying out under the action of the pusher spring. Door springs serve the double purpose of controlling the door movement and locking the whole mechanism together.

There are but two milled parts in the hammer—the driver head and the core end both of which are chrome-nickel alloy steel heat treated. The driver lever is built up from No. 1020 laminations riveted together and pack hardened. Chrome-nickel alloy steel heat treated for toughness also is used for the striker and link pin while the pawl and pusher are 1020 stampings pack hardened. All other parts with the exception of the springs are 1020 sheet left soft. The staple guide Fig. 1*B*, is spot welded in position.

On account of the small size of the parts their proportions were determined by experiment, and it first was necessary to determine the failure point of the materials used in order to provide a sufficient margin of safety.

Happy are the days of the designer who follows through on a wonderful job of designing by including an Alemite High Pressure Lubrication System.

Happier are the days of the designer who definitely specifies the grades of Genuine Industrial Alemite Lubricants which shall be used in servicing this equipment.

It would seem that the time is largely past when it is necessary to call attention to the installation of Alemite Systems. Yet there is equipment actually being sold today which incorporates grease and oil cups and oil holes for "lubrication."

The answer to that one deserves a fur-lined medal as tall as the Empire State Building. WHY?

Yet it is just as important that you specify the *kind* of lubricants which must be used in your Alemite Systems. Random oils and greases which cannot stand the pace of production are not cheap at any price. Alemite Industrial Lubricants are custom compounded to fit every industrial need. They are safe—pure—non-acid—non-corroding—STAY PUT—cannot run out of bearings!

But why argue? If you want to leave nothing to chance in the equipment you design, you will use Alemite High Pressure Systems and specify Alemite Lubricants. If you want to hang your neck out for trouble, you *won't*.

It's up to you! Happy Days?

ALEMITE CORPORATION (Division of Stewart-Warner), 2644 N. Crawford Avenue, Chicago, Illinois 717

Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name..... Company.....

Address..... City..... State.....

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Industry Demanded . . a *Self-tapping Cap Screw*

. . . Opens a New Field of assembly economy

Eliminates tapping—makes stronger fastenings

RADIO manufacturers started it. They were saving a lot of time and labor through the use of slotted head Parker-Kalon Hardened Self-tapping Sheet Metal Screws. But they told us they could speed up their assemblies even more if they did not have to drive in the Screws with a screw driver. So we made the Screws with a hexagon head for them. And, before long manufacturers in other metal working industries discovered that they, too, could use a Hex Head Self-tapping Screw to advantage, not only in the smaller sizes used for radio assembly, but also larger sizes suitable for making fastenings to heavy material.

Now, so that all manufacturers may take advantage of the savings these Screws bring, we offer them in a large range of stock sizes from No. 6 diameter by 3/16" long to 7/16" diameter by 2" long. They can be used to make fastenings to sheet metal from 24 gauge up to 6 gauge; steel plates and structural shapes up to 1/2" thick; and in solid sections of aluminum and die castings, slate, ebony asbestos, etc. In addition to saving money, these Screws actually make fastenings that are more secure under tension, shear and vibration.

Get samples — free — for a trial

You may be able to gain greater assembly speed by using Hardened Self-tapping Cap Screws instead of our slotted head Hardened Self-tapping Sheet Metal Screws. You may be able to save a considerable amount by using these unique Cap Screws to eliminate tapping on heavy metal assemblies. Find out. Send us a brief description of your assembly and we'll furnish samples for trial, free.

PARKER-KALON CORP., 202 Varick St., NEW YORK, N. Y.

PARKER-KALON

HARDENED HEX HEAD SELF-TAPPING

CAP SCREWS

PATENTED—No. 1809758, No. 1927815

ALLOYS (MAGNESIUM)—Various types of sand castings and die castings of magnesium are illustrated in several recent bulletins published by Dow Chemical Co., Midland, Mich. Parts shown include portable tools, vacuum cleaner parts, engines, airplane parts, bus seats, etc.

BEARINGS—Cutless rubber bearings are covered in a new 18-page booklet being distributed by B. F. Goodrich Co., Akron. O. The booklet reviews all phases of the problem of applying the bearings to hydraulic turbines.

CONTROLS (ELECTRICAL)—Monitor Control Co., Baltimore, Md., is issuing a folder on its alternating current washing machine controllers. The controls have automatic reversal and push button control.

DRIVES—Motor reduction units in both the flexible and integral types are presented in bulletin 1164 of Allis-Chalmers Mfg. Co., Milwaukee. The bulletin describes the units, gives a table of ratings and speeds and presents cross sections of the two types in the line which ranges from 1 to 50 horsepower.

ELECTRONIC EQUIPMENT—Rugged industrial type electronic tube controllers known as Photo-Trollers are described in leaflet L-20563 prepared by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The units have only one moving part, a 30-ampere contactor.

FASTENINGS—Parker-Kalon Corp., New York, is distributing a folder on its line of self-tapping cap screws which are hardened and have hexagon heads.

HEATING UNITS—Edwin L. Wiegand Co., Pittsburgh, is distributing a file folder which contains a number of leaflets on electric heating units of all types. The material covers ring, strip, cartridge, immersion, finstrip and hot plate heaters and gives engineering data.

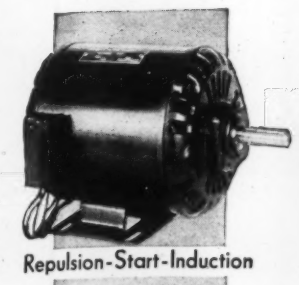
LUBRICATION AND LUBRICATING EQUIPMENT—An automatic, visible lubricating system for ring or ball bearing shafts is presented in recent publications of Trico Fuse Mfg. Co., Milwaukee.

MOTORS—Bulletin E issued by Ohio Electric Mfg. Co., Cleveland, describes the improved capacitor type motor for refrigerator service developed by the company. Performance curves are included.

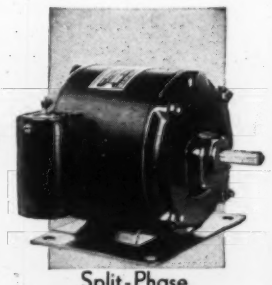
MOTORS—General Electric Co., Schenectady, N. Y., has prepared a catalog insert No. GEA 1538 on its line of totally enclosed squirrel cage motors. The sheet gives applications, features and other pertinent points of information.

MOTORS—A full description of the "Self-Syn" motor manufactured by Ideal Electric & Mfg. Co., Mansfield, O., is given in bulletin No. 540 issued by the company. The bulletin contains complete details of design and construction with illustrations, diagrams and characteristic curves.

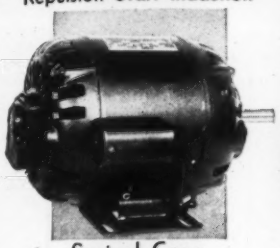
MOUNTINGS (RUBBER)—Lord Mfg. Co., Erie, Pa., has prepared bulletin 100 on its line of shear type machine and instrument mountings of rubber bonded to



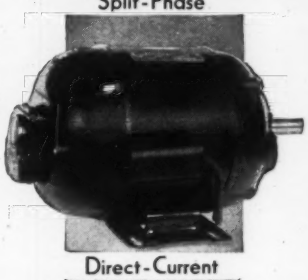
Repulsion-Start-Induction



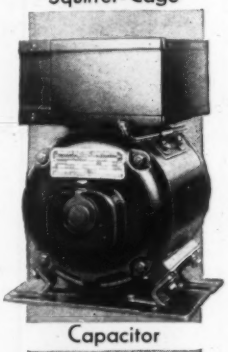
Split-Phase



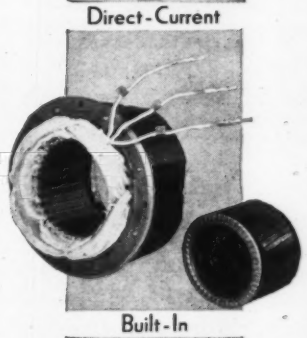
Squirrel-Cage



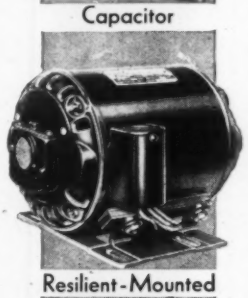
Direct-Current



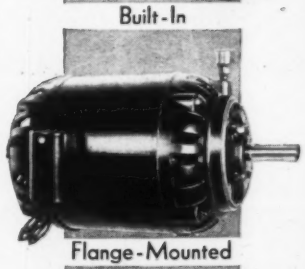
Capacitor



Built-In

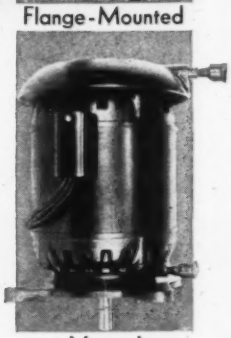


Resilient-Mounted



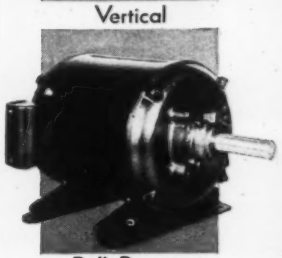
Flange-Mounted

Drip-Proof



Vertical

Explosion-Proof



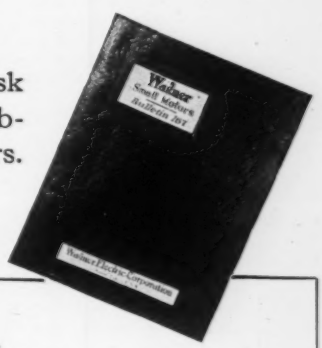
Ball-Bearing

You can Standardize on Wagner Motors

The Wagner line includes all types of small motors generally applied on motor-driven machinery, making it possible for you to standardize on Wagner motors. Whether alternating or direct current; single or polyphase; open, drip-proof, totally enclosed or explosion-proof; rigid or resilient-mounted, flange-mounted or built-in; sleeve or ball-bearing; horizontal or vertical — there's a Wagner motor now in existence, ready to be applied on the job.

There are 25,000 different type-horsepower-speed combinations of Wagner motors (in ratings up to 400 hp). Certainly, your motor requirements are no greater than that!

For complete details, ask for Bulletin 167 describing Wagner small motors.



Wagner Electric Corporation
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Please send copy of Bulletin 167 on small motors

Name and Position

Firm

Address

If interested also in large motors, indicate here ☐

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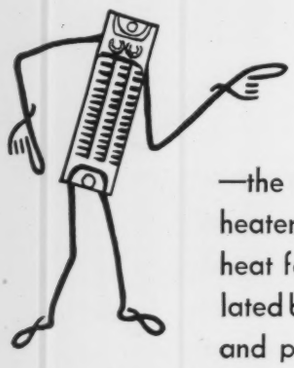
S433-1

G-E Calrod

Handy Heating Helpers

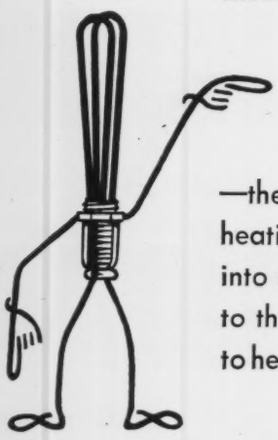
I am "Spot"

—the G-E Calrod cartridge-type, electric-heating unit. I can provide a spot of clean, safe, convenient, precisely-controlled heat just where it is needed in a process or in a machine.



I am "Strip"

—the G-E Calrod electric strip heater. I can provide a strip of heat for machines, processes, isolated buildings, crane cabs, valve- and pump-houses, and scores of those hard-to-heat locations.



I am "Dip"

—the G-E Calrod electric liquid-heating unit. I can be threaded into tanks, pipes, or kettles, or into the compartments of machines to heat oil, water, or other liquids.

571-8

GENERAL ELECTRIC

Many other G-E Calrod "heating midgets" are described and priced in a popular mail-order catalog, GEA-1520, entitled Small Electric Heating Units and Devices. Simply mail this coupon to General Electric Company, Schenectady, New York.

Name.....

Firm.....

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steel. The bulletin gives a complete description of the mountings, their design, and engineering data.

PUMPS—Series 5000 rotary radial piston type pumps manufactured by Northern Pump Co., Minneapolis, are described in a new booklet of the company. Performance curves, dimensions and similar data are included.

RUBBER—Diamond Rubber Co. Inc., Akron, O., is distributing a well-prepared 24-page booklet entitled "Buyer's Guide to Mechanical Rubber Goods."

WELDED PARTS AND EQUIPMENT—A description of the advantages to be obtained through welded construction of machine parts is included in a recent folder distributed by Austin Co., Cleveland.

Research Publications

Tentative Specifications for Gray Iron Castings. These specifications, which have an A. S. T. M. designation: A 48-32 T, cover general gray iron castings not covered by other existing specifications of the society. It is proposed to classify cast irons in respect to tensile strength, and the tentative specifications apply to castings where strength is a consideration. Topics covered include physical properties and tests, chemical composition, workmanship and finish, inspection and certification. Criticisms are solicited by the society. Published by American Society for Testing Materials, Philadelphia. 8 pp. Free.

Creep at Elevated Temperatures in Chromium-Vanadium Steels Containing Tungsten or Molybdenum, by William Kahlbaum and Louis Jordon. Determinations of creep at temperatures between 750 and 1100 degrees Fahr. were made on two tungsten-chromium-vanadium and a molybdenum-chromium-vanadium steel. These steels were tested as tempered after mechanical working (rolling) and are compared with steels of similar compositions which had been oil-quenched and tempered. Published as RP 481 by bureau of standards. Available through Superintendent of documents, Government Printing office, Washington. 15 pp. 5 cents.

Investigation of the Lubricating Process in Sleeve Bearings, by Dr.-Ing. W. Nucker. Bearings have to keep pace with the trend in the design of machines in the direction of increased stressing of individual parts and higher speeds. Although ball and roller bearings are capable of carrying heavy loads, there are so many factors connected with sleeve bearings that they still form an indispensable constructional element, especially in large machines. Fundamental investigations were carried out under various service conditions, on bearings of different construction and with two sizes of play to determine the limit thickness of the carrying oil film and the influence of bearing length. Further tests concerned the distribution of pressure and the dislocation of the shaft, temperatures and local friction, total bearing friction, oil circulation and the influence of design features. Published in German by VDI-Verlag, Berlin. 84 pp. 5 marks.

Business and Sales Briefs

J. E. GREGORY has been appointed sales engineer in the motor division of Apex Electrical Mfg. Co., Cleveland, manufacturer of split phase fractional condenser type, universal fractional and direct current motors. Mr. Gregory has had 15 years experience in the motor industry of which 13 were spent with Domestic Electric Co. and the remainder with Black & Decker Electric Co.

* * *

O. B. J. Fraser has been placed in charge of developments in the uses of nickel and nickel alloys in the oil, gas and coke industries and in the industrial uses of nonmetallic compounds of nickel by International Nickel Co., Bayonne, N. J.

* * *

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., has been licensed by Dardelet Threadlock Corp. to manufacture and sell bolts and nuts with self-locking thread.

* * *

Poole Foundry & Machine Co., Baltimore, Md., has appointed Frank M. Esch, Houston, Texas, as representative for its line of flexible couplings and reduction gears.

* * *

Burgess Battery Co., engineers and manufacturers of electrical and acoustical products, is now located at Freeport, Ill.

* * *

Kinney Iron Works, Los Angeles, has been licensed by Meehanite Metal Corp., Chattanooga, Tenn., to manufacture Meehanite castings under the latter's patents.

* * *

Timken Steel & Tube Co., Canton, O., has appointed Delaware Steel Service Inc., 1614 Summer street, Philadelphia as its exclusive representative in the Philadelphia district for all products of the company.

* * *

George L. L. Davis has returned to the Scullin Steel Co., St. Louis, as vice president in charge of sales. Mr. Davis was connected with the Scullin company from 1904 to 1927.

* * *

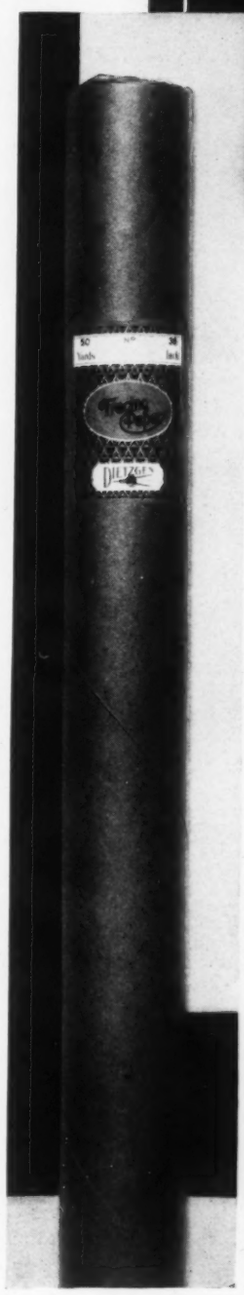
Robert D. Black has been appointed sales manager for Black & Decker Mfg. Co., Towson, Md. Mr. Black has a background of shop experience, plus a number of years as a salesman and later as branch manager of sales in the Pennsylvania territory.

* * *

Philip M. Guba has assumed the post of assistant manager of sales in the Detroit office of Carnegie Steel Co. Mr. Guba resigned his position as assistant manager of sales in the New York office of Republic Steel Corp., a position he has held since that company was formed by merger early in 1932.

* * *

Lukens Steel Co., Coatesville, Pa., has opened a sales office for southeastern territory in the Citizens & Southern National Bank building, Atlanta, Ga. The office is in charge of Adolph Rider Jr., manager of sales. Two years ago the company moved its district headquarters from Atlanta to New Orleans, closing the office in the former city.



ADAPTABILITY

The world regards the works of the ancient Greeks as the epitome in culture. Their adaptability and individuality as characterized in the ceremonial vase have given us the inspiration for grace, beauty of design, and shapeliness of outline ››› The modern artist, be he architect, engineer, draftsman or student ... will better interpret his own ideas of beauty and practicability if he too will individualize his efforts ››› How better to begin than at the beginning ... in your tracings? The "tooth", transparency, glaze, thickness, and strength of the paper ... the hardness of your favorite pencil, kind of ink, style of pen, pressure of your hand, all affect the results. And in the many different tracing papers, vellums, and cloths individualized by DIETZGEN surely there is one to fit YOU.

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